A CRITICAL ANALYSIS OF THE TEACHING AND LEARNING OF NUMBER CONCEPT IN A GRADE 2 CLASS IN THE WESTERN CAPE

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by

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DECLARATION

I, Marie-Louise Scholtz, declare that the contents of this dissertation/thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

MScholtz ______________________ 09/05/2012 ______________

Signed **Date**

ABSTRACT

This action research case study focussed on **the teaching and learning of number concept development.** The research was conducted in an English Grade 2 class in a primary school in a lower socio-economic community in Manenberg on the Cape Flats,

The research is based on the constructivist theories of Piaget, Vygotsky and Feuerstein and was conducted in the paradigm of praxis. The focus of the research was six learners in a class of 43 who were identified by the class educator through the process of continued assessment as needing intervention. Initial data collection was conducted utilising a questionnaire. This instrument was chosen to allow for a gentle introduction and a less threatening means of collecting information from a fellow colleague.

I entered the classroom initially as observer and later as participant-observer. I observed how the class teacher taught the superordinate and subordinate concepts of number concept. Some observation sessions were video-recorded to allow for richer data collection. Follow-up interviews with the class teacher to discuss observations made as well as introduce new teaching methods were audio-recorded. Data were analysed using the process of discourse analysis.

I found that the teacher used a variety of different teaching methods, but tended to gravitate to rote teaching with transcription and drill work to develop and consolidate number concept. The learners acquired number concept by implementing previously taught methods without any real understanding. During intervention, it was noted that the focus group fared better when allowed to use concrete equipment.

The research formed part of an ongoing study that will culminate in the design of a teaching training intervention programme to address number concept issues.

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DEDICATION

I would like to dedicate this thesis to the hardworking teachers of Manenberg who, despite working in difficult circumstances give their all every day.

GLOSSARY

1. Clarification of basic terms and concepts

1.1 Acronyms	Explanation
NDE	National Department of Education
DBE	Department of Basic Education
WCED	Western Cape Education Department
MCED	Metropole Central Educational District
NCS	National Curriculum Statement
ELSEN	Education for Learners with Special Educational Needs
SNE	Special Needs Education
LSE	Learning Support Educator
LTSM	Learner and Teacher Support Material
FfL	Foundations for Learning
WP	Word Problem
HOD	Head of Department
MLD	Mathematics Learning Disability

1.2 Definitions

Learning support teacher	Learning support teachers "teach and support learners with special needs within primary school, both on a withdrawal basis, within the mainstream classroom or in an ELSEN class" in the areas of Literacy and or Numeracy (MCED, 2004:2).
Systemic evaluation	Systemic Evaluation as conducted by the NDE "assesses the performance of the system by gathering and analysing information on learner achievement as well as the context in which teaching and learning takes place. Learners are assessed in key Learning Programmes or Areas, viz, Literacy, Numeracy and Life Skills in Grade 3. Languages, Mathematics, Natural Sciences and Technology in Grade 6 and in Grade 9. Contextual questionnaires are completed by learners, educators, parents and principals. Sampling of schools takes place at provincial and at district level. A sample of not more than 40 learners per school are selected randomly from all Grade 3 learners (WCED, 2007:1)".

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CHAPTER ONE

INTRODUCTION

> We believe that the first step in this process is an understanding of the importance of number sense, its relevance for building mathematical ability in students, and an understanding of limitations in current practice, much of which is not based on the concept of number sense (Gersten & Chard, 2001:13).

1.1 Introduction

In this dissertation I critically analyse the teaching and learning of number concept in a grade 2-class in the Western Cape.

Chapter one includes the rationale, describes the research problem in detail, explains the purpose and provides the context of a critical analysis of number concept development in a grade 2-class in the Western Cape, South Africa. Incorporated into the context is a brief background on the environmental, societal and economic circumstances of the primary school in Manenberg in the Western Cape that denotes the site of the research.

There is also a brief overview of the methodology used and the ethics considered. The data for this research was collected in a case study while conducting action research in praxis. An attempt is made to position my research in alignment with other recent studies conducted in South Africa, as well as internationally, to further validate and support my findings.

I attempt to answer the following research questions during analysis of the data collected.

How do learners in a Grade 2 class in Manenberg acquire number concept skills?

Which teaching strategies are currently used to support the acquisition of number concept skills in a Grade 2 class in Manenberg?

The summary at the end of each chapter explains the fundamental nature of each chapter to follow.

While it is customary to use the words ‘the researcher’ or refer to the researcher in the third person, ‘I’ will be used to denote the researcher in this paper. The rationale for this is that this study is an action research-in-praxis case study and I am a participant observer.

1.2 Rationale for this study

This research forms part of an ongoing study in which my aim is to ultimately develop an intervention programme in number concept development for teacher training. As a Learning Support Teacher (LSE) in two primary schools in Manenberg in the Western Cape, I support learners in intervention in the literacy programme as part of my normal daily duties. Due to time constraints, I am unable to assist in the area of mathematics. To my mind, the only way to support the development of mathematics is to empower the teachers themselves.

I conducted research in Foundation Phase Mathematics to equip myself and others with knowledge and understanding about number concept development. My quest was to have a better understanding of how teachers teach and how learners develop number concept.

"Teachers are the most important resource in a classroom, and learners who learn mathematics do so mainly as a result of good teaching by effective teachers. Unfortunately, more is known about how learners learn mathematics than about the 'best' method of teaching it" (Frobisher et al., 2002: xi). I, therefore, had to develop an understanding of the knowledge base and mathematics stance of the participant teacher and examine the teaching strategies she utilises to facilitate number concept development in the classroom.

In addition, in order to plan meaningfully and to maximise the impact of future intervention programmes it was necessary to investigate the processes whereby grade 2 learners actually develop a sense of numbers.

1.3 Description of the problem

While teaching as a LSE at two primary schools in Manenberg in the Western Cape, I discovered that some of the learners experienced difficulties with the development of number concept in Foundation Phase Mathematics and had no clear understanding of the superordinate and subordinate concepts underpinning number concept. There seemed to be no balance in the development of all the subordinate areas and learners learnt mathematics mostly by rote without any real understanding of the underlying concepts.

According to findings based on results obtained by the Western Cape Education Department (WCED) from the systemic literacy and numeracy evaluation in grades three, conducted during October 2008, the learners at the site of the study fared poorly in the area of Numeracy. Only 22,1% of the learners in grade three attained the pass rate of 50% for Numeracy. Learners fared poorly in areas such as calculations, problem solving, counting and ordering numbers, etc.

I have accessed the systemic results, but in order to protect and respect the confidentiality of the school, I am unable to disclose more detailed information.

1.4 Aim of the research

This research is primarily aimed at improving the teaching of mathematics in the Foundation Phase. This objective will be attained when, through the process of action research, current teaching strategies used to facilitate number sense have been critically analysed and improved upon, more effective teaching strategies have been implemented to foster number concept development and ultimately enhance the quality of the teaching of mathematics, and the appropriate use of Learner and Teacher Support Material (LTSM) has been encouraged to facilitate number concept development.

My secondary aim is to collect data as part of a comprehensive study on number concept development from which an intervention programme in number concept for teacher training as part of an ongoing study can be developed.

1.5 Methodology

Data of how teachers teach and learners develop number concept was collected through action research conducted in the paradigm of praxis. I made field notes of observations and interaction with the teacher and learners who participated in this study, and transcribed the information into a journal. Data was collected during two action research cycles. Action research cycle 1 took place in from June to September 2009 and action researcher cycle 2 from January to March 2010. The data was interpreted through the process of discourse analysis.

The study has been limited to a focus group of six learners in the grade 2 class in a primary school in the Manenberg area.

Upon commencement of this study, data was collected, utilising a questionnaire completed by the teacher. Despite ongoing informal discussions with the teacher, I felt it necessary to conduct a formal interview with her, post action research data collection cycle one, as detailed in chapter 3, in order to clarify information.

1.6 Ethical considerations

> The emphasis is on good principles, adequate for working with human participants in all their complexity. Procedures, techniques and methods, while important, must always be subject to ethical scrutiny. (Ryan, 2006:17).

As qualitative data is open to interpretation by the researcher, I took great care to ensure that the viewpoints of the participants are reflected honestly and guarded against any personal biases, beliefs, values and personal interpretations of the curriculum that could have influenced the study.

Consent was obtained from the Western Cape Education Department (WCED), and the Governing Body and Principal of the site of the research. The Head of Special Needs Education and the Head of Learning Support Educators of Metro Central District were also informed and guidelines were negotiated, so that the research would not impact upon my daily tasks as a LSE. An agreement was negotiated with the teacher regarding what was mutually acceptable to both of us during my visitations to her classroom as a participant observer.

The parents of the learners were informed regarding the research and what it would entail. The anonymity of all participants and the confidentiality of all information were guaranteed and only pseudonyms were used. Participation was voluntary. I obtained permission from the school and the teacher to use video and audio recordings to capture data. Video footage and audio recordings were viewed by me and my supervisors. The recordings were used as a method to capture data and will be handed to the class teacher upon completion of the thesis. The participant teacher has verified the accuracy of the data contained in **Chapter Four** of this thesis.

1.7 Delineation of this study

The following information is included in order to delineate the socio-economic context of the primary school as situated in Manenberg where the research was conducted. Manenberg is situated on the Cape Flats in the Western Cape and is regarded as a poor socio-economic area. The following data has been taken from Statistics South Africa based on the Census 1996 and 2001 (University of Stellenbosch and Transformation Africa, 2004).

- The percentage of unemployed people in the Manenberg area was given as 19.3%. This is higher than the provincial average of 17%. The percentage of unemployed people has increased by 4.9% from 1996 to 2001.

- The average income of household per year in Manenberg is R49 472 compared to the provincial average of R76 000.

In the United States, a significant number of learners living in low- income communities who start school at age five or six, are behind in the development of their conceptual understanding of number (Halberda et al. 2008:655; Griffen 2004:40-41; Caulfield 2000:63). Most learners acquire basic number concept informally through interaction with family members in the home before entering the formal schooling system (Gersten & Chard, 2001: 4).

While I am not exploring the impact of the social environment upon the academic progress of the learners of Manenberg, as this is not the focus of the research, I accept that social factors may play a big role in the stimulation that the learners received at home prior to attending school, even though they may have been born with an inherent numerical ability.

Further limitations imposed upon this study is the fact that the research was conducted in one grade two classroom in one primary school in the Manenberg area and focussed upon six learners and one teacher. Research was conducted in the English stream at the school and did not include Afrikaans speaking learners.

The first cycle of action research was implemented during the third school term of 2009 and was conducted over a period of sixteen sessions on a Monday, Tuesday and Wednesday. This was very unsatisfactory as I was not able to always see the conclusion of a concept and had to rely on secondary information such as the work completed in the learners' books as well as the teacher's planning. This was then followed by a second cycle of action research in which the teacher and I reflected upon the observations made during the first cycle. The second action research cycle was conducted during the first school term of 2010 as the WCED does not allow any practical research to be conducted during the last school term of a year.

The process of action research has its own set of limitations. This study is very specific and I had to be careful not to generalise when comparing similar studies as the participants are all individuals and will therefore not react the same as other participants in different circumstances. While there will be some similarities in the way teachers teach and learners learn, this study may produce different results at other schools.

The school at which research has been conducted is dual medium and there is only one English Grade 2 class teacher who is currently also the Foundation Phase Head of Department (HOD). I chose to do action research and conduct a case study in this class as the teacher is in a position to advise and guide other teachers in her department in the development of number concept teaching strategies which will further enhance the impact of the research.

There are many dynamics that could have had an impact on the validity of the results of my research. I am a learning support teacher at the site of the research and in this position have formed a bond with the Grade 2 teacher who is the HOD overseeing learning support as well as the Institution Level Support Team (ILST) coordinator. As a learning support teacher, I report to her and work with her to facilitate intervention in the school. I entered the classroom as a researcher, learning support teacher and participant observer. I discussed the ramification of the different roles in the teacher's classroom with her at length prior to commencing research. As mentioned above, an agreement was negotiated with the class teacher under these circumstances before initiating the data production phase.

1.8 A reflective summary

This chapter is mostly dedicated to an explanation of the rationale that led me on my research journey. I also describe the aims of my research, along with problems I attempted to solve and then provide a brief outline of the methodology used to conduct the research. This is followed by a description of the delineation of the research which includes the economic circumstances of the area where the research site is situated. The following diagram provides a brief schematic summary of the most important facts included in the chapters contained in this thesis. This is followed by a short summary of the information included in each chapter.

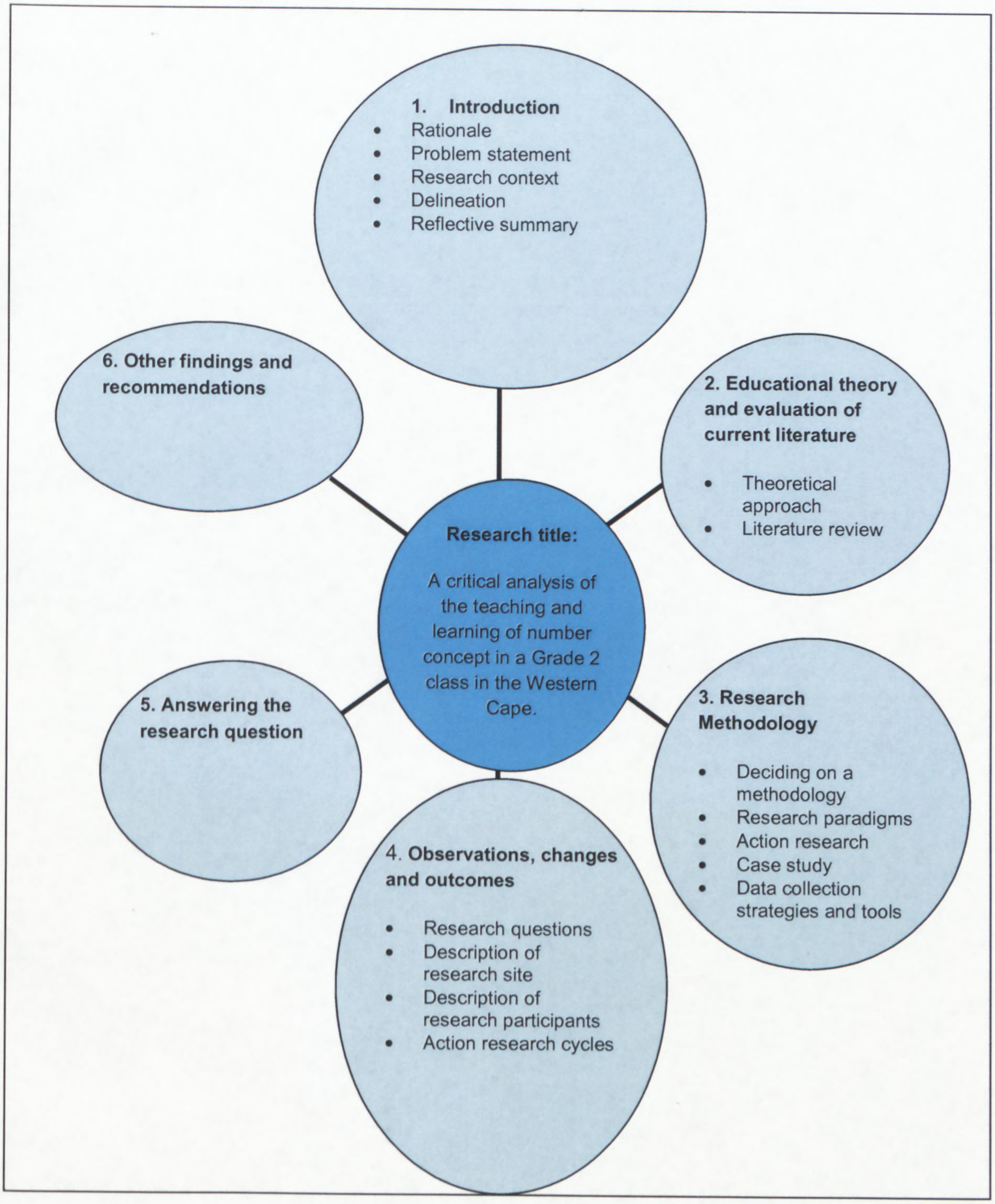

Figure 1.2: Overview of thesis

Chapter Two describes the educational theories of Piaget, Vygotsky and Feuerstein. Piaget's stages of development, Vygotsky's constructivism and Feuerstein's cognitive thinking strategies greatly underpin my research into the development of number concept. Included in this chapter is a discussion of occurrences in the educational development of South Africa as well as an overview of policies, curricula and strategies pertaining to number concept. An overview of number concept as defined by various authors, as well as a discussion of the importance of number concept is provided. This is followed by international perspectives regarding the superordinate and subordinate areas of number concept.

Chapter Three outlines my journey to place my research within an epistemological, axiological and ontological framework. Different paradigms such as praxis, constructivist and positivist, are discussed and compared. The rationale for using action research in praxis is provided. A detailed discussion of action research in praxis is followed by a discussion of the salient features of the case study. The advantages and reason for choosing specific data collection methods and strategies to collect my data are presented.

Chapter Four includes a detailed description of the participants and the research site. The delineation of the study was deliberated and explained. The different action research cycles examined what was initially observed, the intervention and the resulting changes implemented.

Chapter Five endeavours to answer the research questions stated by using the data collected during my observation sessions in the classroom. The superordinate and subordinate concepts of number sense development guides the analysis of the data and the answering of the research questions.

Chapter Six includes other important data collected during the observation sessions in the mathematics class and recommendations for further study and research in the area of number concept development.

CHAPTER TWO

EDUCATIONAL THEORY AND EVALUATION OF CURRENT LITERATURE

2.1 Introduction

In this chapter, various definitions of number concept and the importance of the acquisition of number concept as a prerequisite to achieving success in mathematics are discussed in detail. This chapter further engages with the policy, strategies and development pertaining to number concept in South Africa as well as perspectives of other authors regarding research conducted in the superordinate and subordinate aspects of number concept. I endeavour to place my research in an educational theory context. The educational theories that best support my research and what I aim to achieve, are those of Piaget, Vygotsky and Feuerstein. Each of these theorists will be discussed in detail.

2.2 Theoretical approach

The constructivist approaches of Piaget, Vygotsky and Feuerstein provide the suitable educational foundation for my research. After intensive and extensive reading, and due consideration given to its relevance and appropriateness, I have found these constructivist theories to best inform my research. The combination of social and cognitive constructivism attempts to address the development of the learner more holistically. Each theorist is to be discussed separately. My discussion will highlight how these educational theorists and their respective theories underpin my research questions.

Piaget (1955:23), also cited in Atherton (2005:1), is considered to be a cognitive constructivist and his research encompasses the learner's maturation in direct relation to the learner's increased cognitive understanding of the world through the process of assimilation and accommodation. Piaget (1955:2) and Atherton (2005:3) refer to the level of the learner's cognitive development and the readiness of the learner to perform certain tasks during specific levels of this development between the ages of 18 months and approximately 12 years of age. Piaget states that the learner initially is unaware of himself as a person and only sees his interaction with the objects around him. As he[1] develops intellectually he discovers that he exists among other objects in the world which is separate from him. Piaget suggests that during the

[1] *he* is used for ease of reference, but refers to both sexes.

sensori-motor stage (Birth - 2 years), the learner is able to differentiate himself from objects. Learners learn to use language and name objects during the pre-operational stage of development (2-7 years). This is followed by the concrete operational stage (7-11 years) when learners are able to think and reason logically about objects and events that occurred within their ambit. This is the age group into which the focus group at the site of my research belonged. During the formal operational stage (11 years and up), learners can think and reason about abstract concepts as well as test hypotheses (Atherton, 2005:3).

Piaget's operational view of knowledge is considered one of his most important contributions and has significant implications for education. Piaget's operational view of knowledge includes knowledge of what could happen, what should happen and also what couldn't or shouldn't happen. Piaget deduces that because there is a qualitative difference in the types of knowledge that adults and learners attain then the types of thinking at earlier developmental stages differs from thinking during later stages. Piaget goes further and says that the basis of cognitive development is conceptualisation. I used this theory as motivation to formulate the hierarchy of concepts that are the focus of my research in number concept. Piaget used his experiments with learners to see whether learners when successfully completing tasks were fully conscious of what they were doing and why they were doing and not just completing the tasks successfully by chance (Piaget, 1955; Benjamin, 2005:29).

During the course of my research I investigated whether the teacher's instructional plan and choice of resources for the teaching of number concept were in fact appropriate for the learners' level of cognitive development as measured against the Piagetian stages of development (7-11 years concrete operational stage) (Atherton, 2005:3). Furthermore, the investigation centred on how the teacher modified her instruction with respect to number concept development to cater for the cognitive developmental levels of particular learners who might still be operating on the pre-operational stage (2-7 years) of cognitive development (Atherton, 2005:3).

Upon investigation of the above, the aim was to establish in which ways the Piagetian stages of cognitive development underpinned teaching practice geared toward the development of number concept in a Grade 2 class in a primary school in Manenberg.

Vygotsky, considered to be a social constructivist, measured the cognitive development of the learner as that which the learner can achieve while working in partnership with the teacher or with other learners (Blunden, 2001:5). He named the area between what the learner can do by himself and what he can do in collaboration with others, the "zone of proximal development". The "zone of proximal development" thus defines the range of potential each learner has for learning. This learning is influenced and shaped by the social environment in which it takes place (Nicholl, 1998:2).

Vygotsky differs from Piaget with respect to cognitive development in that he believed that "learning leads development' and not that "development leads learning" (Blunden, 2001:5). In my opinion both hold true. I believe that learning is cyclical. Learners have prior experiences and knowledge. However, as they discover new knowledge, they assimilate and accommodate the knowledge which then leads to further development of the knowledge base of the learner. This brings about new questions in the mind of the learner and motivates the learner to explore and discover knowledge to answer these questions.

The National Curriculum Statement (NCS) Mathematics (South Africa. NDE[2], 2003:57), supports this opinion and states that the purpose of Numeracy as described in the Numeracy Learning Programme Statement of 1997 is to "use the learner's own innate, intuitive and experientially acquired knowledge and ability in number and space as a springboard into continued learning". The learner's prior knowledge allows for further learning to take place. A further purpose of numeracy is that learners should "develop the ability to communicate mathematically, work co-operatively towards solving problems and use correct mathematical terminology and symbols" (South Africa. NCS, 2003:57). Learners thus apply their acquired knowledge to facilitate further development.

Frobisher et al. (2002:ix) maintain learning to be "a social process" stating, that "it is a sharing of experiences and knowledge; teachers interact with children and children with each other." In the course of answering my research questions, Vygotsky's social constructivist approach supports my experience of how the teacher plans and implements her number concept development lessons to allow for learner-learner interaction in the making of meaning and the application of knowledge.

Feuerstein (Kozulin, n.d.:4) differs from Vygotsky in that he believes that everyone has unlimited potential that can continuously be transformed and is not merely restricted by a zone of proximal development. Both Vygotsky and Feuerstein place strong "emphasis on the constructive activity of the student, the cognitive-developmental appropriateness of material, and the involvement of the teacher in the design and implementation of classroom activities above and beyond a mere provision of knowledge" (Kozulin, n.d.:4). In this research, I critically analyse the manner in which Learner and Teacher Support Material (LTSM) is used in order to ascertain the impact of

[2] National Department of Education

the effective use thereof upon the development of number concept in learners of the English Grade 2 class mentioned previously. Vygotsky and Feuerstein both advocate learner – learner interaction and learner – material interaction during problem solving activities.

The NCS Mathematics is based upon outcomes which require the development of critical thinking strategies (South Africa. NDE, 2002:1). Feuerstein (Kozulin, n.d.: 1) advocates the use of mediated learning to encourage learners to think and discover for themselves. In this study, attention has been given as to how the teacher encourages the development of cognitive thinking strategies, while mediating number concept development.

2.3 Number concept development

My first approach is to explore the literature which relate to the area of number concept development. In reviewing the current thinking on the teaching and learning of number concept, I will focus on the following:

- Definitions of number concept
- The importance of number concept
- How number concept develops;
- Policy, strategies and development in South Africa that pertain to the teaching of mathematics and specifically number concept;
- Perspectives of other authors on the superordinate and subordinate concepts of number concept;
- The importance of number patterns in the development of number concept;
- The importance of place value in the development of number concept;
- The importance of word problems in the development of number concept;
- The teaching and learning of number concept; and
- The use of LTSM in the development of number concept.
- Interruptions to instructional time

2.3.1 What is number concept?

The discipline of mathematics consists of three worlds namely: "the actual quantities that exist in space and time; the counting numbers in the spoken language; and formal symbols, such as written numerals and operation signs" (Griffin, 2004: 40). Number concept necessitates the composition of a rich set of relationships among these worlds. Learners must first be able to match "actual quantities" with "counting numbers" before they will be able to make sense and construct relationships between these three worlds. For the purpose of this study the words "number concept" denotes "number sense".

In my quest to form an understanding of what number concept entails and which underlying concepts contribute to the development thereof and are included therein, I consulted various journals and other research material. I found that, despite numerous attempts by various authors, no consensus has been reached in the mathematical world as to a universally acceptable definition of number concept. The various definitions range from one sentence hypotheses to lists of concepts that purport to define number concept. Included below are some examples of varied definitions found in the literature.

Mooney et al. (2003:26) who prefer the word number sense rather than number concept, define number sense as follows: Number sense is "an understanding of the size of a number and where it fits in our number system."

Other authors highlight the following in an attempt to define number sense: Number sense is an innate sense of numbers and their relationships; Number sense is being able to accurately distinguish between sets of a cardinal value greater than four; Number sense includes counting, number knowledge and the application of number knowledge to add and subtract. (Jordan et al., 2007:42, Wilson Carboni, 2001:1, Clark & Grossman, 2007:51).

Berch (2005:333) attempts to define number concept in Figure 1.1 below. These alleged components of number sense as collated by Berch, consists of a variety of skills, knowledge, perceptions, and constructs and illustrates that number sense is a very complex concept that is difficult to define. Berch found it necessary to list all the possible aspects that he considers to define and describe number concept rather than the shorter definition of the authors discussed above.

1. A faculty permitting the recognition that something has changed in a small collection when, without direct knowledge, an object has been removed or added to the collection.
2. Elementary abilities or intuitions about numbers and arithmetic.
3. Ability to approximate or estimate.
4. Ability to make numerical magnitude comparisons.
5. Ability to decompose numbers naturally.
6. Ability to develop useful strategies to solve complex problems.
7. Ability to use the relationships among arithmetic operations to understand the base-10 number system.
8. Ability to use numbers and quantitative methods to communicate, process, and interpret information.
9. Awareness of various levels of accuracy and sensitivity for the reasonableness of calculations.
10. A desire to make sense of numerical situations by looking for links between new information and previously acquired knowledge.
11. Possessing knowledge of the effects of operations on numbers.
12. Possessing fluency and flexibility with numbers.
13. Can understand number meanings.
14. Can understand multiple relationships among numbers.
15. Can recognize benchmark numbers and number patterns.
16. Can recognize gross numerical errors.
17. Can understand and use equivalent forms and representations of numbers as well as equivalent expressions.
18. Can understand numbers as referents to measure things in the real world.
19. Can move seamlessly between the real world of quantities and the mathematical world of numbers and numerical expressions.
20. Can invent procedures for conducting numerical operations.
21. Can represent the same number in multiple ways depending on the context and purpose of the representation.
22. Can think or talk in a sensible way about the general properties of a numerical problem or expression—without doing any precise computation.
23. Engenders an expectation that numbers are useful and that mathematics has a certain regularity.
24. A non-algorithmic feel for numbers.
25. A well-organized conceptual network that enables a person to relate number and operation.
26. A conceptual structure that relies on many links among mathematical relationships, mathematical principles, and mathematical procedures.
27. A mental number line on which analogue representations of numerical quantities can be manipulated.
28. A nonverbal, evolutionarily ancient, innate capacity to process approximate numerosities.
29. A skill or kind of knowledge about numbers rather than an intrinsic process.
30. A process that develops and matures with experience and knowledge.

Figure 2.1 Alleged components of number sense (Berch, 2005:333).

To facilitate my understanding of what number concept means in the context of this study, I attempted to devise a table that will explain what I understand as the superordinate and subordinate concepts underpinning number concept development in a grade 2 class. As Berch (2005:333) indicates, there are many more skills and concepts not included in the table that contribute to the development of number concept and the importance of these skills such as the ability to "understand numbers as referents to measure things in the real world", should not be discounted.

For the purpose of this thesis, I utilised the above definitions as well as aspects highlighted by the authors previously mentioned to determine the two most important superordinate concepts that are vital to learners practising and learning mathematics in a grade 2 classroom and focussed my research mostly on the teaching and learning of these concepts.

The term "superordinate" has its origin in the early seventeenth century and consists of the word "super" meaning 'above' and is built on the pattern of the word "subordinate – hence "superordinate" *Oxford Dictionaries Online* defines the term "superordinate" as " a thing that represents a superior order or category within a system of classification (Oxford Dictionaries Online, 2011). The term "subordinate" means: "of less or secondary importance" (Oxford Dictionaries Online, 2011).

The following quotes give a clear description of the terms "superordinate" and "subordinate" as regards to teaching:

> The superordinate class is the class of which the concept you are teaching is a member. Thus if you want to teach about nouns (the concept) the superordinate class might be parts of speech. The superordinate is the level directly above the level of the concept you are teaching...
>
> Subordinate concepts are those which are subdivisions of the concept being taught (Street, n.d.:1).

I use the terms "superordinate" and "subordinate" in an attempt to describe the hierarchy of the concepts and sub-concepts that I concentrated on in my study of the development of number concept.

Table 2.1: Superordinate and subordinate concepts of number sense

Superordinate concepts	Counting, Calculations.
Subordinate concepts	**Counting:** rote, one-to-one correspondence, conservation of number, subitizing, sequencing, estimation, comparison **Calculations:** more, less, addition, subtraction, multiplication, division, estimation, doubling and halving, building up and breaking down, comparison

In conclusion, as it is not possible to find a universal definition of number concept at the time of this thesis, I will focus more on the lack of number concept development and the impact thereof on the mathematical development of the learners in the grade 2 classroom in Manenberg. The above table 2.1 will merely serve as a guideline to focus my observations in the classroom and to determine the scope of my research.

2.3.2 The importance of number concept

In a study conducted by Locuniak and Jordan (2008:453) they conclude that number concept and working memory in kindergarten would be a strong predictor of later calculation fluency. Number concept "lays the foundation for learning formal math concepts and skills in elementary school" (Jordan et al., 2007:36) and "is a reliable and powerful predictor of math achievement at the end of first grade" (Jordan et al., 2007:42).

Even though Mathematics Learning Disability (MLD) is not the focus of this dissertation, it is a disorder that affects many learners. A further aim of my research is to collect information to draw up an intervention programme for teacher training in the area of number concept development. Part of that programme will include strategies to deal with learners who have MLD. Mazzocco and Thompson (2005:151) conducted research about factors that predict MLD in learners in the third grade in America. The researchers utilised cognitive data obtained from psycho-educational- or neuropsychological assessments to predict math achievement. The assessments used included spatial skills, number concept development and working memory. The results showed that deficiencies in the development of number concept and spatial skills as well as working memory are clear indicators of Math Learning Disability (MLD).

Some researchers have discovered that the understanding of number concept is an accurate predictor of mathematical ability in high school learners and correlates with the learner's previous scores on standardised maths tests extending back to kindergarten (Halberda et al. 2008:665; Chard et al., 2008:12).

The understanding of number concept is as important to mathematics learning as phonemic awareness is to reading (Gersten & Chard, 2001:18). The authors demonstrate how number concept can enlighten and augment intervention strategies for learners with MLD. They believe that number concept development, together with research from cognitive science, will combine earlier research conducted in mathematics to form an effective intervention to improve instruction of mathematics. "This number sense not only leads to automatic use of math information, but also is a key ingredient in the ability to solve basic arithmetic computations" (Gersten & Chard, 2001:20).

Howell and Kemp (2009:60) claim that, contrary to the above findings regarding the importance of competency in number concept as predictor of later success or difficulty in mathematics, any extrapolative value of number concept assessments must be regarded as precipitate. However, the idea that number concept supports early mathematics competency is now accepted in both current research documents and curriculums, despite the fact that there is no agreed upon definition of this concept (Newman & Way, 2009:412).

Francis Fennel, (2008:1) the president of the National Council of Teachers of Mathematics from 2006-2008, states that: "Number sense is important and needed – right now." It is his dream that all learners will develop a strong sense of numbers to accompany their learning in mathematics from kindergarten to high school.

In conclusion, there is an international as well as national focus on the importance of number concept in promoting mathematical proficiency in learners.

2.3.3 How does number concept develop?

There are different schools of thought about where number concept originates and how it develops. Caulfield (2000: 64) re-examines Piaget's theory that babies and young children develop their logical thinking abilities through interaction with the world. Caulfield argues that while Piaget made some perceptive observations about children's cognitive functioning, his theory is defective, because today's researchers contend that babies have an intuitive understanding of basic number operations.

Halberda et al. (2008:665) support the notion that the development of number concept is genetic in nature and that all humans and animals are born with specific knowledge of numbers or number sense. Human mathematical competence depends on competence in an area of mathematics which relies on symbolic representation and their inherent number concept that is shared by adults, children and animals.

Griffen (2004:40), Caulfield (2000:63) and Fennel (2008:1) also support the perception that babies are born with structures in the brain that are purposely attuned to quantity in number. A strong foundation for number concept is present in the earliest months of a baby's development. Babies' brains are able to understand basic numerical concepts and basic computations. They are born with an inherent mathematical knowledge which is added to as the brain develops. By age four, children have gained the perceptual understanding of quantity and counting. At age five to six, children combine these two understandings to a single conceptual understanding of number. This conceptual understanding becomes the foundation for number concept and provides the basis for all higher level mathematics.

This number concept is then further developed at school through a range of mathematical experiences. These experiences should include exercises in place value, addition and subtraction, composing and decomposing numbers, etc. Number sense requires an understanding of communitative, associative and distributive properties and how they are used in the four basic operations (Griffen, 2004:40, Caulfield, 2000:63, Fennel, 2008:1).

All recent research indicates that children are born with an inherent sense of number. While supporting this theory, I am concerned with how this inherent ability is then nurtured and developed at school level.

2.3.4 Number concept development in South Africa

Since the first democratic elections in 1994, there have been a number of changes in education in South Africa with schools becoming racially integrated and the various education departments amalgamating into one National Department of Education.

Initially, The Ministry of Education introduced three national curriculum reform programmes focussed on schools:

- Removing all racially offensive and outdated content from the curriculum,
- introducing continuous assessment, and
- Introducing outcomes-based education (Jansen, 1998:321).

The Minister of Education then launched Outcomes Based Education (OBE) (*Curriculum 2005*) on 24 March 1997 (Jansen, 1998: 321). The *NCS Mathematics* (South Africa. NDE, 2002) informs teachers regarding the content, teaching strategies and the minimum achievement requirements for each phase and grade. The *NCS Mathematics* (South Africa. NDE, 2002:12) incorporates all the identified key areas related to number concept in Learning Outcome 1. Learners must learn to count, identify number patterns, solve basic operations, master concepts such as conservation and ordering of numbers, etc. Learners are also required to use their number concept knowledge to solve problems pertaining to real life contexts.

In the post-apartheid era, teachers were not trained to implement the new curriculum, but rather oriented to the National Curriculum Statement (NCS). Teaching strategies and how learners acquire knowledge were not accentuated sufficiently. This has been a major barrier as there is no single 'one size fits all' theory on how to teach learners to read, write and calculate that can be applied successfully in all classrooms (South Africa. WCED, 2006:1).

Systemic research conducted by the National Department of Education (NDE) and the WCED found that only 36% of Grade 3 learners were achieving the outcomes as set out in the curriculum for literacy and numeracy. The systemic evaluation results correlated with levels of poverty in South Africa (South Africa. WCED, 2006:1).

This information was confirmed by research conducted into numeracy development in the Western Cape in South Africa based on the systemic results of grade 3 learners during 2002 and 2006. The following graph clearly illustrates that learners in the lower quintile[3] schools in the Western Cape experience more difficulty with concepts relating to the development of number than learners in higher quintile schools.

[3] Quintile refers to the classification used to identify the socio-economic status of schools e.g. the higher the quintile rating the more affluent the school.

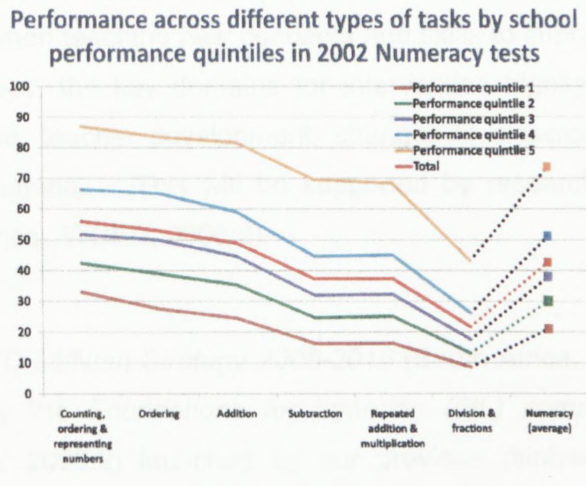

Figure 2.2 "Performance across different types of tasks by school performance quintiles in (grade 3) 2002 numeracy tests" (University of Stellenbosch Research team et al., 2010:4).

The *Western Cape Education Department (WCED) Literacy and Numeracy (Lit/Num) Strategy 2006 – 2016* (South Africa. WCED[4], 2006) was launched as a comprehensive literacy and numeracy strategy to support and strengthen other strategies launched by the WCED in 2002/3. The approach to the numeracy part of the Lit/Num strategy is based on the theoretical underpinning of constructivism.

> In the teaching and learning of numeracy the construction of knowledge in a way that is meaningful for learners is particularly important. However, the construction of knowledge in numeracy is both an empirical activity and an abstract reflection. It is recognised by the WCED that both understanding and practice are essential to develop a deep understanding of numerical and mathematical concepts. Teaching numeracy therefore means teaching through numerical activities (South Africa. WCED, 2006:2).

The teaching strategies should thus include learner participation, concrete, semi-concrete and abstract discovery, and implementation of and refection upon mathematical knowledge.

[4] Western Cape Education Department

The WCED identifies "mental skill and competency" as "critical aspect(s) of becoming numerate" (South Africa. WCED, 2006:2). The Lit/Num strategy advocates that an iterative approach be followed when teaching new concepts and skills to improve the numeracy levels of the learners. In numeracy, the key domains for intervention highlighted by the strategy are a pre-school programme, teacher development, changes to classroom practice and learning and teaching support material. This will be supported by research and ongoing monitoring and support (South Africa. WCED, 2006:2).

The *WCED Lit/Num Strategy 2006-2016* (South Africa. WCED, 2006) is supported and further refined by the *Foundations for Learning (FfL) campaign 2008 - 2011* (South Africa. FfL campaign, 2008:2) launched by our previous minister of Education, Naledi Pandor. This campaign sets the guidelines for the teaching of mathematics in South Africa. The campaign "provides clear directives to the entire education system on minimum expectations at each level of the General Phase of schooling" in South Africa in the areas of Literacy as well as Numeracy.

The *FfL campaign 2008 – 2011* (South Africa. FfL campaign, 2008:5) requires that each teacher in the Foundation Phase teach Literacy and Numeracy skills every day. The **minimum expectations** are that Foundation Phase teachers will teach mathematics for at least one hour every day. Ten minutes of the lesson should be devoted to mental mathematics exercises. Grade 2 class teachers are **expected** to teach Numeracy for 1, 5 hours per day which provides a total of 7, 5 hours per week (South Africa. FfL campaign, 2008:7).

The educators also received work schedules as part of the FfL campaign to act as guidelines for all learning areas from the WCED at the beginning of 2009. These work schedules were field tested by the educators from July 2009. The work schedules consisted of quarterly, weekly and daily planning. The work schedules were accompanied by teacher's guides for each learning area and are very specific showing exactly what should be taught, how it should be taught and which apparatus should be used. It also gives a clear explanation of which learning outcomes are covered on that specific day for that specific learning area.

Research conducted into numeracy development in the Western Cape in South Africa based on the systemic results of grade 3 learners during 2002 and 2006 illustrates that despite all the intervention, policies and curriculum changes, very little has changed for our learners. Figure 2.2 show that there has been no noticeable improvement in the numeracy scores of the systemic evaluation between 2002 and 2006 in South Africa.

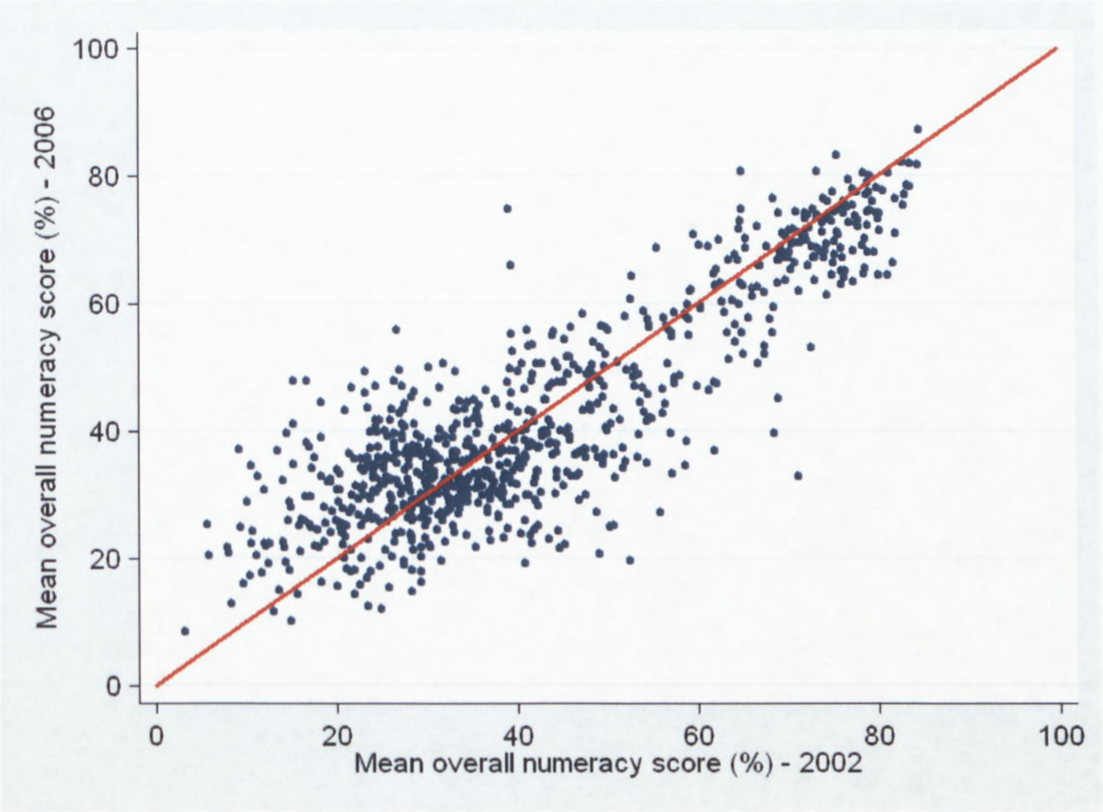

Figure 2.3 A comparison of the grade 3 numeracy scores for 2002 and 2006 (University of Stellenbosch Research team et al., 2010:3).

The National Department of Education divided into the Department of Basic Education and the Department of Higher Education at the end of 2009 (D. Burger, 2011:1). There has recently been renewed focus upon the importance of the acquisition of number concept as a prerequisite to promote mathematical proficiency in learners. The Department of Basic Education of South Africa has published a handbook for Foundation Phase teachers as well as sets of workbooks for learners in the area of number concept and promulgates the following:

"Critical to be able 'to do mathematics' is the development of a strong sense of number. Learners who leave the Foundation Phase with a poorly developed sense of number are almost certainly unable to ever make sense of mathematics" (South Africa. DBE, 2009:9).

2.3.5 Perspectives on the superordinate and subordinate concepts of number.

I will now discuss literature pertaining to the teaching and learning of each superordinate concept and the underlying subordinate concepts[5] in the area of number concept development referring to international as well as national research and the NCS of South Africa.

> Students with number sense understand that numbers are representative of objects, magnitudes, relationships, and other attributes; that numbers can be operated on, compared, and used for communication. It is fundamental knowledge that mathematics, grounded in number and with all its rules and operations, has an inherent "sense" that can be used by the student in flexible ways to solve problems (Gurganus, 2004:55).

To understand what number concept[6] is and the importance thereof in the learning of Mathematics, it is necessary to critically evaluate current research already conducted in this area. Number concept is the 'glue' that connects all mathematical problem-solving across the curriculum. Learners are born with a propensity for making meaning of quantity in number, but if this ability is not honed then they will struggle to acquire and master mathematics. Teachers of young learners often forget that not all learners automatically develop number concept. Learners acquire number concept in different ways. Some develop these skills informally and other need stimulation and active exposure to number activities to refine their number concept skills. A lack of number concept is a key indicator of later difficulties in mathematics (Chard et al., 2008:12).

Frobisher et al. (2002: ix) identify three key areas where number concept plays a role. These areas are numbers and the number system, calculations and solving problems. These areas are included in the NCS Mathematics in learning outcome 1 (South Africa. NDE, 2002:12).

2.3.5.1 Counting

I will now discuss the superordinate concept of counting as well as the subordinate concepts namely, rote counting, counting one-to-one correspondence, conservation of number, subitizing, sequencing of numbers, estimation and the comparison of numbers.

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[5] See table 2.1

[6] Number concept denotes number sense

> There is a long history of research into young children's development of number knowledge prior to formal schooling, and counting skills have long been recognised as essential building blocks of mathematical understanding (Howell& Kemp, 2009:48).

The NCS Mathematics, (South Africa. NDE, 2002:23) requires that learners in Grade 2 should perform in number concept development activities within the minimum required number range of 0-200. The assessment standards for the grade 2 learning area mathematics (South Africa. WCED, 2002: 1) necessitate that learners should be able to:

- Count to at least 100 everyday objects reliably.
- Count forwards and backwards in:
- ones from any number between 0-200
- tens from any multiple of 10 between 0 and 200
- fives from any multiple of 5 between 0 and 200
- twos from any multiple of 2 between 0 and 200
- Knows and reads number symbols from at least 1 to 200 and writes number names from 1 to at least 100
- Orders, describes and compares the following numbers:
    - Whole numbers to at least 2-digit numbers
    - Common fractions including halves and quarters (South Africa. WCED, 2002:1)

In the South African context the FfL campaign (South Africa, 2008:16) entails that a Grade 2 class teacher spend 5 minutes of her daily mathematics lesson on different counting activities such as counting using a number square, counting on a number-line, counting forwards and backwards from a given number to a given number, counting in multiples, odd and even numbers, etc. This is supported by Frobisher et al. (2002:25) who also specify the use of LTSM such as discrete objects, number rods, number-lines and base 10 apparatus to encourage counting.

At present both the NCS and FfL must be applied in conjunction with one another, thus causing considerable confusion amongst teachers. The management team of the school, that denotes the site of this research study, has made a decision that the teachers in this school use the FfL document to guide their planning and the other supporting documentation received from the NDE/Department of Basic Education and WCED merely as resource material.

Counting is an intricate process comprising of many sub-skills such as rote counting, one-to-one correspondence and conservation of number. Counting requires two discrete skills. The first skill is to recall and produce the number names in the correct order. The second skill requires that the learners match each of the number names with one object that is being counted (Van de Walle, 2003:117).

Rote counting is when learners merely repeat the 'number rhyme' (Anghileri, 2002:21). It is the easiest concept to master. Teachers must, however, not assume that although a learner can count to 100 by rote that the learner has an understanding of the concept of counting or the numbers that are being counted as this is not necessarily true (Baratta-Lorton et al., 2010:5.1).

There are many different activities and strategies to teach **rote counting**. It is important to note that teaching the learner to remember the number names in order requires daily practice over a period of time utilising different methods such as a variety of concrete apparatus, number rhymes and number games. It is recommended that the learner first master counting in rote to ten before proceeding to bigger numbers. (Anon., 2010:1).

One-to-one correspondence is when the learner realises that for each object he[7] is counting there is a specific name (Anghileri, 2002:21). In a small study conducted by Ee et al. (2006:332) in three cities, Singapore, Beijing and Helsinki with 10 boys and 10 girls (between the ages of 4 and 7) from each city, the researchers found that even though the learner had mastered readiness skills for basic mathematics such as conservation of number, they still struggled with formal counting skills. The researchers stress that it is vital that teachers for pre-school and lower primary school learners "engage young children in meaningful and interesting activities using concrete materials, exciting games, and role plays that use mathematics in daily situations" (Ee et al., 2006:332).

Sequencing refers to the ordering of numbers in a specific pattern. Competence in counting includes being able to count backwards and forwards, counting in multiples, conservation of number and the ability to be flexible with numbers (Beswick et al., n.d.:2). Researchers conducting a study in Singapore, Beijing and Helsinki found that a significant proportion of the participants experienced difficulty with sequencing of numbers, counting (mental) to 20, counting backwards and counting in multiples and suggested that these areas should receive extra teaching attention from pre-school and lower primary school teachers (Ee et al., 2006:332).

The following number concept exercises, identified by Gurganus (2004:55-58) and Hopkins et al., (2001:12) will contribute to the promotion of number concept through counting skills

- Couple numbers to objects that have meaning as learners will then experience numbers as values rather than labels. (Learners need to understand the purpose of counting in order for counting to be meaningful.)

[7] He refers to both male and female in this dissertation.

- Model maths sentences about numbers to enable learners to learn how to talk about the relationship between numbers.
- Begin all maths lessons with counting activities such as counting on and back, using number rhymes and action songs. (Counting builds the relationship between numbers as well as their size.) Further extend counting by including different number patterns.
- Provide activities using number-lines, measuring tapes, clocks, calendars, dice, etc. to encourage counting.
- Plan significant estimation activities. Estimation should not just be a guessing game, but should be based on previous experience e.g. how many learners are in the classroom today?
- Find everyday uses for numbers.
- Explore unusual and interesting numbers.

Counting skills form an important part of the understanding of calculations. The more skilful a learner is in counting, the easier calculations will be for that learner. Initially learners learn to count and apply their counting to simple calculations. Counting then develops through the understanding of place value which allows for big numbers to be counted. Thereafter learners develop an understanding of negative numbers and fractions (Frobisher et al., 2002: 27; Hopkins et al., 2001:9).

Efficient and accurate counting strategies are a necessity for accuracy in arithmetic as well as proficiency in mathematics (Gersten et al., 2005:302).

The understanding of the **conservation of number** is explained as a learner's ability to comprehend that quantity is not influenced by any re-arrangement of the objects (Anghileri, 2002:21). Piaget came to the conclusion that many of the children in the pre-operational developmental stage (2-7 years) are not able to form an understanding of the conservation of number as they are not yet able to understand the principle of reversibility, compensation and identity. Piaget proposed that number conservation only develops when the child reaches the concrete operational stage (7-11 years) and is able to think logically and reason about objects and events (Agger, 2007:28, Atherton, 2011:1-2).

Most learners are, when they first come to school, able to identify the amount of dots on a card when organised in the same pattern as on dice or dominoes. This ability is identified as **subitizing**. Instant recognition of the how many of a number of objects or dots encompasses being able to think about patterning and the ability to construct relationships. This aptitude to instantly recognise the amount without counting can then assist with the development of a further skill such as counting on (Van De Walle et al., 2010:130).

There are two different types of subitizing. Perceptual subitizing as seen to be closest to the original definition which states that subitizing is the recognition of a number without using any other mathematical processes such as counting. Conceptual subitizing refers to learners who just know the value of a concrete or semi-concrete representation of a number. They are able to instantly identify the patterns within the number display. These learners can look at a domino and say that it represents the number 8 in total, but also consists of two displays of the number 4, etc. They can identify the value of parts of the pattern as well as the whole pattern and are able to transfer this knowledge to other situations such as counting on. These learners through their understanding of the part whole relationships in the value of the number are thus able to construct and reconstruct numbers. These are vital skills for the understanding and manipulation of numbers during calculations. (Clements, 1999:400)

Estimation is one of the skills identified by Berch (2005:333) as necessary for the development of number concept. Learners find it difficult to understand the concept of estimation and need to be guided utilising different types of activities to develop an understanding. The following estimation questions can be used to facilitate understanding of the concept of estimation:

More or less than _____________?

Closer to __________ or to ___________?

About ___________________?

Practise in estimation should allow for more than one exercise in which to estimate using the same type of unit e.g. using string to estimate how many times it would go around various learners' wrists (Van de Walle et al., 2010: 140-141).

There is a positive correlation between performance in estimation and performance in basic arithmetic operations (Jordan et al., 2006:155).

2.3.5.2 Calculations

In the South African context, the FfL campaign (South Africa, 2008:16) recommends that the Grade 2 class teacher should spend at least 10 minutes daily on calculations as part of her lesson on oral mental maths and number sense problems. The activities could include flashcards with addition and subtraction combinations, games, simple oral word problems, doubling and halving, etc. The Grade 2 class teacher should also spend at least 50 minutes daily introducing new concepts to 2 groups of learners on their ability level such as the basic operations, sequencing, measuring, etc. The concepts are described in detail in the NCS Mathematics (South Africa. NDE, 2002:20-31).

The assessment standards for the grade 2 learning area mathematics (South Africa. WCED, 2002: 1) state that learners should be able to:

- Perform calculations, using appropriate symbols, to solve problems involving:
    - addition and subtraction of whole numbers with at least 2 digits;
    - multiplication of whole 1-digit by 1-digit numbers with solutions to at least 50;
    - estimation
- Perform mental calculations involving:
    - addition and subtraction for numbers to at least 20;
    - multiplication of whole numbers with solutions to at least 20
- Use the following techniques:
    - building up and breaking down of numbers;
    - doubling and halving;
    - using concrete apparatus (e.g. counters);
    - number-lines

The subordinate concepts for calculations are: **more and less (comparison), addition, subtraction, multiplication, division, estimation, doubling and halving, and building up and breaking down of numbers**.

Various teaching strategies can be used to enable learners to master **basic calculations**. In one of these strategies, the learners start through the process of 'all-count'. Learners calculate that 3+5= 8 by counting out three objects and five objects. They then count all the objects together starting at number one, counting from one to eight. The next strategy is to teach learners to count on and back to work out their answers. There is progression in the way that learners solve problems and calculate answers. This strategy relies on number-lines and number charts to help them to visualise the process (Hopkins et al., 2001:18).

Breaking up and building up numbers is an efficient strategy to assist learners to master mental calculations. The following steps are implemented to support learners in the development of calculation strategies: use of fingers to represent initial problems; adding or subtracting one or two to start with; doubling; "recomposing" numbers to 5+? and 10+?; bonds of ten; looking for numbers that make up ten when adding or subtracting; number patterns; and finding ways to turn "unfriendly" numbers into "friendly" numbers (Hopkins et al., 2001:19).

Learners often experience difficulty with the interpretation of computations as they have only memorised or partly memorised the procedure to solve the problems. They will use any basic operation to solve the problem as they have no real understanding of what is required and often are not able to remember what the different symbols mean. This illustrates that learners have over time become used to using the four basic operations without any real understanding as teachers have used the memorising method to teach numbers (Anghileri, 2002:1).

Frobisher et al. (2002:143) agrees with Anghileri (2002:1) and "stress that following rote procedures is not conducive to engendering in children the desire to think and operate mathematically." Teachers should ensure that learners have a good working knowledge and understanding of numbers before teaching computations.

Gersten and Chard (2001:2) advocate the use of cognitive strategies and the development of number sense to support learners with intervention in mathematics rather than previously used drill and practice instruction methods. While encouraging the understanding of the concept of calculations and the various methods to enable fluent calculation is of utmost importance, a major goal of mathematics intervention should still be fluency and proficiency in basic arithmetic combinations (Gersten et al., 2005:302). One reason why fast recall of basic arithmetic combinations is important, is that the learners use so much of their thought processes to work out the arithmetic that they are unable to effectively comprehend, discuss or use any kind of problem-solving methods or number concept strategies.

Mental maths strategies are of the utmost importance to assist with the solving of problems. Accomplishment in mental mathematics has a positive effect on the development of learner's self-esteem and confidence. " If children are to perceive mathematics as something they 'can do' and are able to take some pleasure in, then learning to solve problems and puzzles mentally, no matter what magnitude, is an important aspect of raising self-esteem" (Ollerton, 2004:71).

It is better to integrate number concept activities and the mechanical learning of number facts than to teach these skills successively (Gersten and Chard, 2001: 5). It is likely that some students who are taught to memorise number facts mechanically will never develop number concept.

Ollerton (2004:74) does not support the use of speed tests to promote basic operation fluency in learners. Learners should be allowed to share their mental mathematics methods with others to allow them to refine methods and to apply mental mathematical problem-solving to a variety of problems.

Learners who have not developed any real understanding of the logical structure which underpins number and number operations, have no understanding of the relationships between numbers that allows them to interpret new problems in terms of the knowledge that they have already mastered (Anghileri, 2002:1). Teachers should not focus their instruction simply on ensuring that the learners know and can apply the various math rules (Griffin, 2004: 39). Learners who only learn the rules do not develop a real understanding of the meaning of numbers and of the operation signs.

2.3.6 The importance of number patterns in the development of number concept.

"The study of algebra begins as they (the learners) observe how numbers form systems and as they generalize number patterns" (National Research Council, 2001:42). Number patterns include multiples, addition and subtraction patterns and sequencing. Learners must learn to recognise number patterns and relationships to enable them to work efficiently with numbers. They must be able to apply their number knowledge to solve real life problems in a world that is technologically orientated (Anghileri, 2002:3).

Number patterns assist learners with basic arithmetic (Jordan et al., 2006:155). If 4+4 = 8, then 4+3 is one less, namely, 7. Learners who have a grasp of number patterns can use them to solve unknown computations. e.g. 9+7=16; 19+7=26; etc.

The teaching of number patterns forms a critical part in the development of number concept. Number patterns help to make predictions and develop ideas of sequencing. There are number patterns within the basic operations. Number patterns help learners to make sense of mathematics and the world (Frobisher et al., 2002:244; Anghileri, 2002:3).

The assessment standards for the grade 2 learning area mathematics (South Africa. WCED, 2002: 2) necessitate that learners should be able to copy and extend simple number sequences to at least 200. Learners should also be able to use a number-line correctly to perform calculations when solving problems involving addition, subtraction and multiplication.

2.3.7 The importance of place value in the development of number concept.

The concept of place value is underpinned by the grouping of single objects or a group of objects to form a collective unit and plays an important role in the development of number concept (Frobisher et al., 2002: 37).

There are four central processes to learners' understanding of place value (Frobisher et al., 2002: 39). These processes are counting, partitioning, grouping and number relationships. 'Counting' should not only be restricted to counting in ones in sequence, but should also include counting in tens, hundreds and thousands. There are two stages of 'partitioning' that are of importance for the development of place value. 'Unique partitioning' is when learners can write a number as a tens and ones value. 'Multiple partitioning' is when learner can write 59 as 4 tens and 19 ones. 'Grouping' as described by Frobisher et al. (2002: 40) corresponds with the building up and breaking up of numbers as taught in the NCS (South Africa. NDE, 2002). 'Number relationships' refers to the understanding of the relationships between numbers.

2.3.8 The importance of Word Problems (WP) in the development of number concept.

The solving of WP forms an integral part of the number concept development of learners. Performance on arithmetic and WP correspond strongly from the beginning of kindergarten (Jordan et al., 2007:43 – 44). To solve a WP, a learner must be able to form a visual or mental presentation of a number problem that is presented verbally, and decide what type of calculation is required to solve the problem. WP is thus of primary importance in the development of number concept as the learner is required to manipulate numbers and understand and compare quantities.

The methodology of problem-posing and problem-solving to help learners learn mathematics is grounded in the constructivist educational theories of Vygotsky and Feuerstein. Ollerton (2004:9) would like learners to attain meaning and sense of mathematical concepts for themselves.

The assessment standards for the grade 2 learning area mathematics (South Africa. WCED, 2002: 1) state that learners should be able to perform calculations[8], using appropriate symbols, to solve problems and should be able to explain own solutions to the problems.

The FfL campaign (South Africa, 2008:16) outlines that of the 50 minutes used for the teaching of new concepts in the Grade 2 class, 15 minutes should be set aside during the lesson to concentrate on the solving of WP. The grade 2 class teacher should pose problems based on the concepts that she is introducing. Learners should then be allowed to solve these problems unaided and share the solutions of the problems with one another. Different solutions and possibilities should be discussed.

Souviney (2006:3) differs from the FfL (South Africa, 2008:16) in that he encourages that the teachers should begin with whole class problem-solving warm-up activities and not just mental maths to encourage "divergent thinking and cooperative problem-solving behavior." In my opinion both lesson structures could be used depending on the responses of, and benefit to, the learners.

The following criteria should be followed for the formulation of WP (Souviney, 2006:6). The learners should be able to understand the problem easily, but the solution should not be easily accessible. The learners should be motivated by the problem to want to solve it and find it intellectually stimulating. There should be more than one solution to a problem. The WP should be based on previously taught concepts which the learners have already mastered. The time factor needed to solve the WP should be taken into consideration. The WP should be open-ended and thus lead to more problems. All subjects can be integrated in the mathematics WP. WP should be well defined so that the learners know when they have solved them.

Several different strategies exist for the teaching of WP. Xin et al. (2008:1-2) conducted research in the solving of WP with Grades 4 and 5 learners from two public elementary schools in the Midwest of the United States of America. Learners who were successful in the solving of WP could identify the mathematical structure of the sum quickly and accurately in any given context. They were able to recall the mathematical structures and apply it to a wide range of WP. The learners were also able to focus on what information was relevant pertaining to the solving of the problem and what was not. The researchers believe that the development of a set of WP related grammar questions will guide learners in the organisation of information and the expression of mathematical relationships. The research conducted shows a significant increase

[8] See 2.3.2.3

in learners' performance level in the successful solving of WP. The learners moved away from previous haphazard impulsive manipulation of the numbers to obtain an answer and focused more upon comprehension of the WP as a written text.

During the process of teaching in a problem-solving manner, Ollerton (2004:12) allows all learners to have an opportunity to offer some kind of answer to the problem and encourage the use of different strategies to solve a problem. This leads the learners to discover even more complex areas of mathematics. In order for learners to internalise concepts, learning should include participatory dialogue (South Africa, 2008:16). Learners should therefore be encouraged and trained to discuss how they solved their WP and share different types of solutions with one another, reflecting upon the most efficient way to solve the problem (Hopkins et al., 2001:2). Problem-solving allows learners to explore mathematical relationships in a variety of different situations while encouraging mathematical decision making. Problem-solving promotes the making of own decisions, the utilisation of a variety of strategies and the linking of different areas of mathematics as well as integrations of mathematics with other subjects.

When learners develop their number concept in daily activities, they will grow in mathematical thinking and confidence and become enthusiastic about maths. Number concept is an important part of problem-solving. Learners develop and use their number concept to develop strategies to help them solve problems. "By helping your children develop number sense, especially in the context of problem-solving, you are helping them believe in themselves as mathematicians." (Wilson Carboni, 2001:4).

2.3.9 The teaching and learning of number concept

The following quote describes how all learners should experience mathematics in an ideal classroom. With these contrasting statements about what mathematics entails, Ollerton (2004:8) wants to create awareness of how learners are taught and the way they learn mathematics impacts upon their perception of the subject. The same could be said about learners' perception of number concept which forms an integral part of the subject, mathematics. It is up to us as teachers to provide learners with the chance to experience mathematics as a positive part of their daily lives by making their teaching activities interesting and providing many real life contextual problem solving opportunities.

> "Mathematics is beautiful, intriguing, elegant, logical, amazing and mind-blowing; a language and a set of systems and structures used to make sense of and describe the physical and natural world. It is a set of tools and processes used in decision making, a discipline upon which questions are formulated and problems are solved. It is used to model environmental conditions and applied to make sense of social phenomena. Mathematics can help build bridges and bring food to the hungry. Mathematics is frightening, boring, debilitating and can appear illogical; a thing many people made, or make little sense of at school." Ollerton (2004:8).

Even though research is providing new insight into mathematical learning and areas of mathematical content and the processes in constructing mathematics are included in the new curricula, learners are still not achieving as expected (Jaworski, 2004:17). Factors impacting on the successful learning of mathematics include:

- Classrooms as they are presently organised and resourced, do not always allow for the development of higher order thinking skills.
- The teacher's job is demanding and multi-faceted. Classroom management strategies do not always allow for the development of learners' thinking skills.
- Some teachers challenge their learners, but end up giving the answers and explaining, as learners do not have the necessary skills to meet these challenges.

Socio systemic factors such as the "physical conditions, authority structures, attitudes, teacher-pupil relationships, textbooks, examinations, and time" impede the introduction and development of thinking strategies in the classroom (Jaworski, 2004:18).

In the United States in a study conducted by Faulkner (2009:24-25) it was found that teachers did not have a clear understanding of number concept and the importance thereof in the development of mathematical proficiency in learners. In the past, teachers were not trained how to develop number concept in their learners. There was and is currently no clear understanding or definition of number concept. It is easier to recognise when a learner has number concept than it is to define what number concept is. Teachers teach mathematics the way that they have been taught. In the past teaching relied heavily on procedural efficiency. Teachers support the conceptual understanding of numbers, but are not always able to explain the logic behind an answer. It is therefore crucial for teachers to have a comprehensive understanding of what number concept entails and be able to explain it in relation to the concept that they are teaching, to be successful. (Faulkner, 2009:27).

In a study conducted by Newman and Way (2009) to empower Kindergarten teachers in meeting the diverse needs of learners in mathematics as well as the support of learners who lack number concept, they identified the following four crucial factors that impact upon the teaching and learning of number concept and mathematics:

- the ongoing development of the teachers' knowledge of both the subject and teaching methodology,
- the need to change how teachers teach,
- the strategies used in the subject of mathematics and
- The impact of teachers' motivation and enthusiasm for the subject.

"Teachers' individual perceptions and the differences they bring to their classroom environments are becoming increasingly recognised as fundamental contributors influencing the way they teach, and how they motivate and engage their students" (Newman & Way, 2009:411).

Teachers' number concept knowledge as well as their attitude to mathematics influence their planning and teaching of number concept development (Yang et al., 2007:383; Mooney et al., 2003:20). This may have a negative influence on how learners develop number concept as the teachers may not be able to teach due to a personal lack of relevant knowledge. "Our primary role as teachers is to establish a nonthreatening environment to encourage efficient problem-solving behaviours among our students. "We must also have the courage to learn along with our students, because many of these important problem-solving skills may be as new to us as to our classes" (Souviney, 2006:3).

Effective teaching depends on "the mutual and interdependent interaction of three elements - mathematical content, teacher, students – as instruction unfolds" (Kilpatrick et al., 2001:9). The quality of the teaching depends on how cognitively demanding the tasks are that were selected by the teacher. Learners should have enough time to interact with the tasks. The high expectations of the teacher coupled with her knowledge of the learners' different abilities and backgrounds serve to motivate her learners and influence the difficulty of the tasks that she sets.

Some learners, who attend school for the first time, bring with them their inherent knowledge of number concept, but are unable to connect this prior knowledge with the more abstract number symbols and signs, formal methods and language of mathematics (Newman & Way. 2009:412). The teachers' knowledge of number concept, the attention given to number concept in her teaching and her understanding impact greatly on the effective teaching of number concept of learners who attend school for the first time. The teachers' motivation and enthusiasm for the development of number concept has a profound influence on how the learners experience number concept activities.

While planning, teachers should keep the following in mind (Ollerton, 2004:13): Teachers should know what they want to teach in a specific lesson and how this fits into the long term plan or scheme of work. The teaching of mathematics and number concept is guided by the learners and not by prescribed curricula. How the teacher teaches and how the learners will experience mathematics is dependant upon the teacher's short-term planning and the interactions that take place during the lesson. Learners are encouraged to discuss and reflect upon what they are learning. Ollerton (2004:14 - 18) encourages the use of open-ended questions to allow learners to experience a variety of different ways to solve the problems. "Procedural fluency and automaticity" is of primary importance for learners who experience difficulty with mathematics to enable them to master important math concepts and skills (Chard et al., 2008:14). Every lesson should contain ample opportunity to consolidate and practise earlier concepts and skills taught. Extension tasks should be provided with opportunities to apply the knowledge gained in different situations.

Ollerton (2004:102-103) suggests using the following five principles to compile a scheme of work to guide the teaching of mathematics and the development of number concept.

- Creating a modular structure
- Using problem-solving approaches
- Access and extension
- Providing opportunities to practise specific skills
- Pleasure

Some of the strategies deemed necessary for success in the instruction of mathematics by Gersten and Chard (2001: 9-10) are to allow learners to develop the ability to start with the larger number when adding, to encourage learners to develop a mental number-line and to provide learners with multiple opportunities to verbalise their understandings and rationales of all the strategies that they are using.

Teaching to ensure mathematical proficiency requires "conceptual understanding of the core knowledge of mathematics, students, and instructional practices needed for teaching; procedural fluency in carrying out basic instructional routines; strategic competence in planning effective instruction and solving problems that arise while teaching; adaptive reasoning in justifying and explaining one's practices and in reflecting on those practices; and a productive disposition toward mathematics, teaching, learning, and the improvement of practice" (Kilpatrick et al., 2001:11).

Teachers therefore play a pivotal role in how learners acquire number concept.

2.3.9.1 Teaching strategies and methods to enhance number concept.

Teachers in general education, special education and English Second Language teachers from Minnesota collated a glossary of math teaching strategies during 2001-2002. The MERLOT program for the California State University in partnership with higher education institutions, professional societies and industry have compiled a similar glossary of teaching strategies and methods that have been added to from 1997 to 2010 (National Center on Educational Outcomes, 2002:1-3; MERLOT, 2010:1). The following list of teaching strategies and methods that could contribute to the teaching and learning of number concept were extracted from these glossaries:

- Differentiated teaching: Learners are grouped according to ability and work at different levels in one classroom.
- Daily revision of previously learned material: Revising or bringing in previously taught material to build on each day to expand the base knowledge of the learners.
- Teaching in a realistic context: Involve the learners' daily life and use the everyday experiences as context in problem solving activities.
- Problem centred instruction: Understand the question, identify relevant and not relevant information, choose a plan of action, solve the problem and check the answers.
- Graphic organisers: Visual displays such as number-lines, 100-charts, etc.
- Peer tutoring and collaborative learning: Learners are grouped into pairs or small groups to solve problems and to assist one another in discovering the answers to problems.
- Games: Using games to reinforce what has been learnt during a follow-up lesson.
- Thinking aloud: Learners are given the opportunity to explain what they are doing as they are working.

These teaching strategies and methods are very effective tools for the development of number concept and could be used by teachers to enhance the teaching and learning experience of learners in the mathematics classroom.

2.3.10 The use of Learning and Teaching Support Material (LTSM) in the development of number concept.

The FfL campaign (South Africa, 2008:17) provides teachers with a list of recommended resources for the learners as well as the classroom. Apparatus for learners include counters, number dice, place value cards, individual abacus, etc. LTSM for the teacher includes 2 D shapes, 3 D objects, teacher's abacus, dice, etc. Number-lines, number friezes, large number squares, etc form part of what should be on display on the wall of the classroom for the learners to use as points of reference. Researchers such as Anghileri (2002:10) and Borgioli (2008: 187) agree that a variety of resources should be used in the teaching of mathematics and specifically in the development of number concept.

Initially, concrete materials should be used during the development of number concept, but learners should be encouraged to use mental imagery while solving problems to help them to make the shift from concrete to abstract reasoning (Anghileri, 2002:10). "Any tool that students find meaningful and useful" should be used (Borgioli, 2008:187). Students should decide which tools or representations to use and how to use them to aid problem-solving meaningfully.

Learners must be able to apply knowledge to different problem situations. Hopkins et al. (2002:1) advocate that learners be encouraged to "generalise and abstract from particular situations and experiences, so that they can move from concrete to abstract and back again." We must therefore teach our learners the ability to transfer knowledge and to have a good understanding of mathematical concepts and relationships.

Teachers should use a variety of happenings, apparatus and games to capture the attention of the learners and encourage problem–solving (Ollerton, 2004:22). The author deplores teachers who will not allow learners to use manipulatives such as paper for paper-folding, peg boards, Cuisenaire rods, etc in the mathematics classroom (Ollerton, 2004: 57). "Play is a necessary process, an important precursor to learning" (Ollerton, 2004:58). The author states that the purpose of using resources and how they are used is of great importance to the learning process. He further proposes that learners be given the option of using manipulatives or not. Learners who use a kinaesthetic learning style might prefer to use manipulatives.

Diezmann and English (2001:1) conducted a study for mathematical gifted students (age 5-8) in an elementary school. They designed enrichment experiences for gifted learners to develop a number sense of multi-digit numbers. The activities relied on the use of concrete apparatus and the development of cognitive reasoning strategies to apply the knowledge experienced while working with the concrete apparatus. Diezmann and English (2001:6) discovered that young learners were "unaware of the existence of large numbers". Through these concrete experiences the learners became fascinated by the multi-digit numbers and were able to transfer knowledge to other subject areas such as interpreting distance in space. Concrete apparatus can thus be used to allow learners to discover new concepts while applying what they have learnt with smaller numbers to bigger numbers as yet unknown.

The Early Learning in Mathematics Programme (ELM) introduces learners to three-dimensional models such as counters and sticks, then move on to two-dimensional objects such as the number-line and dots, and finally to mathematical symbols to solve even more difficult calculations (Chard et al., 2008:13). This progression from the concrete to the abstract supports the conceptual development of learners and correlates with the stages of development of Piaget.

The ELM highlights the importance of using a number-line while teaching learners to count. The programme introduces a number-line with number 1 to 3 on a line with an arrow. As numbers are introduced, numerals are added on the number-line. As the numbers progress beyond 20, only a limited number set is allowed (20-29). The number-line is used for counting, identification of numbers, writing, numerical value, position and sequencing. The systematic building of a mental number-line is of the utmost importance in the solving of addition and subtraction problems on the abstract level (Chard et al., 2008:13).

Number concept in learners can be developed by using an assortment of different classroom activities. The authors advocate the use of graphic representations such as the ten frame and the hundred chart. The ten frame is used to allow learners to practise the pairs of numbers that make up ten (Wilson Carboni, 2001:2; Chard et al., 2008:13).

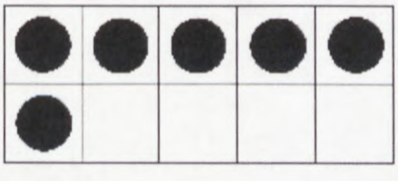


Figure 2.4 The ten frame (Wilson Carboni, 2001:2).

The hundred chart is an effective tool to use to develop learners' number concept. It is a visual representation of numbers and organises them in a logical way. The hundred chart can be used to visually present number patterns (Figure 2.2), for counting and identification of numerals. Learners examine number relationships by building a number chart. They can practise counting on and back as well as counting in multiples. The chart can also be used as a visual aid to support problem-solving. (Wilson Carboni, 2001:2; Chard et al., 2008:13).

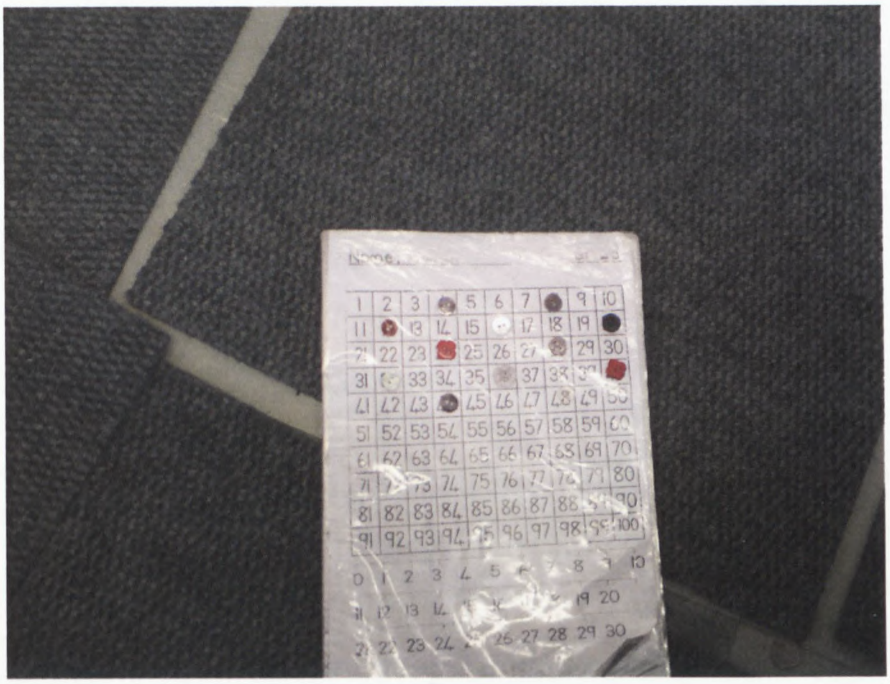


Figure 2.5: A hundred chart used by learners at the site of research.

A calendar can also be utilised to do a variety of mathematical activities. "Learners can work with counting, patterns, number sequence, odd and even numbers, and multiples of a number; they can also create word problems related to the calendar" (Wilson Carboni, 2001:2). Calendars can also be used to identify numbers and patterns and note holidays and birthdays. Learners can count the school days using tallies (Chard et al. 2008:18).

Base ten blocks and place value mats can be used successfully in the teaching of place value. (Chard et al., 2008:13).

Yang and Li (2008:454) discuss the important influence that textbooks may have upon the teaching of number concept. They come to the conclusion that teachers will not include number concept related activities if it is not contained in the textbook they are using. Teachers are often too dependent on textbooks and may as a consequence neglect very important areas of number concept development such as the decomposing and composing of numbers.

2.3.11 Interruptions in instructional time

Interruptions in mathematics instructional time have an enormous impact upon the teaching and learning of number concept in the classroom. The FfL campaign (South Africa, 2008:6) suggests that a grade 2 class spend a **minimum** 1 hour per day learning, practising and being taught mathematics. The FfL campaign (South Africa, 2008:17) makes further suggestions as to how this time should be utilised namely 5 minutes for counting exercises, 10 minutes for mental maths and number sense problems, 5 minutes for the giving of instructions and the handing out of books, 25 minutes for two groups to be taught concepts in small group activities which must include problem solving and 10 minutes for two groups to consolidate previous work taught with written activities. This leaves little or no room for interruptions of any kind during the mathematic lesson.

In a study conducted in Canada in a quest to improve the achievement of learners across the curriculum, it was found that the attitude of teacher's about constant interruptions of instructional time varied from indignation to indifference (Leonard, 2001:107-108). The most frequent sources of interruptions were identified as the school intercom, message delivery, unspecified visitors, other teachers, other students, parents and the telephone. More than half the teachers who took part in this survey indicated that they considered these interruptions a serious problem as learners were distracted and instructional time wasted. Some of the schools in the study had strict policies in place to protect instructional time, but it was not always acted upon.

2.4 Conclusion

In essence, this chapter provides the educational theories underpinning my research, as well as national and international perspectives about number concept. Piaget's stages of development, Vygotsky's constructivism and Feuerstein's cognitive thinking strategies are discussed in depth. These educationalists' theories underpin my research.

Also included in this chapter, are attempts of various authors to define number concept, a discussion of the importance of the acquisition of number concept as a prerequisite for success in mathematical competency and a description of South African policies, strategies and curricula regarding number concept. The superordinate and subordinate aspects of number concept guiding my research are discussed in detail.

The importance of the role of the teacher and the various teaching strategies that could be used to develop number concept successfully in learners are also discussed. These two salient issues form part of the focus of my research. I also discuss perspectives about the impact of constant interruptions upon the teaching and learning of mathematics.

Chapter Three details the methodological aspects of this research. The rationale for utilising a case study through the implementation of action research in praxis is provided. Various aspects of the case study as well as action research in praxis are discussed in detail. This chapter includes a description of the research site, participants and context of the study. How the data were collected, is also disclosed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Chapter Three documents my journey to place my research in ontological-, epistemological- and axiological terms. My research is based on reality as I experienced it, and the research objectives outline the need for action and consequent change which will be discussed later in this chapter. It was clear to me that action research in praxis was the most appropriate research methodological approach for this study.

Consequently, this chapter gives a detailed account of the relevant characteristics of action research. It includes a description of action research, the historical context of action research, case study as research design and the methods used to collect data. A concerted effort is made to discuss the rationale for having decided on action research as praxis as a research method to conduct this investigation. A description of the objectives of the study and an outline of the research design, as well as an overview of how the data was collected, will be included in the discussion of the action research case study in praxis as a methodology.

I was further motivated to use action research after critically analysing other educationalists such as Le Grange (2001), Koshy (2006) Adendorff (2007) and Pine (2009) found action research to be appropriate for the kind of research that I am conducting.

The following quote regarding action research and the expressed commitment to educational improvement contained in it, also strongly influenced my decision to conduct action research:

> Action research is an intervention in personal practice to bring about improvement. The action is not haphazard or routine, but driven by educational values that need to be explored and defended. It is a practical form of research that recognises that the world is not perfect and that professional values have to be negotiated. A central value that is accepted by most action researchers is the value of respect for others which means that their views and values must be accommodated. The role of 'others' in action research is a central concern that needs to be given careful thought (McNiff et al., 1998:16).

This quote speaks to how my study will be conducted. The teacher and the learners in the focus group are central to my research. Their role and actions will provide the data as to how teachers teach and how learners learn and develop number concept.

3.2 Aims and objectives of the study

My study is primarily a critical analysis of the teaching and learning of number concept and is also aimed at improving the teaching of mathematics in the Foundation Phase. This will be attained through the process of action research. Current teaching strategies used to facilitate the conceptualisation of number concept are critically analysed and improved upon, and additional teaching strategies are implemented to encourage number concept development and ultimately enhance the quality of the teaching of mathematics. The appropriate use of Learner and Teacher Support Material (LTSM) is encouraged to facilitate number concept development.

In the process, I collect data as part of a comprehensive study on number concept development to allow me to develop an intervention programme in number sense for teacher training as part of an ongoing study.

3.3 Research design and methodology

3.3.1 Deciding on a methodology

In the quest to decide upon a methodology to conduct research for this study I had to become familiar with the concepts of methodology, epistemology, axiology and ontology. It is important to position my study in an epistemological, ontological and axiological framework and to choose the correct methodology to collect and interpret the data. In order to best describe how the research was conducted, it is necessary first to provide descriptions of the terms used in this study.

The terms 'methods' and 'methodology' are often confused or used as synonyms. Bogdan and Biklen (1998:31) are in agreement and define the terms as follows: "*Methodology* is a more generic term that refers to the general logic and theoretical perspective for a research project. *Methods* is a term that refers to the specific techniques you use, such as surveys, interviews, observations – the more technical aspects of the research". Henning et al., (2007:36) further elucidates the difference between 'methods' and 'methodology'. "The term 'method' denotes a way of doing something (one thing). Methodology refers to the coherent group of methods that complement one another and that have the 'goodness of fit' to deliver data and findings that will reflect the research question and suit the research purpose." The methodology is determined by the data collection requirements of the research question and in turn informs the research design.

In order to select the appropriate research methodology it is important to deal with the fundamental ontological, epistemological and axiological assumptions. For the sake of clarity I find it necessary to explain the meaning of the word 'assumption.' Robinson (2007:1) defines 'assumption' as "... a realistic expectation... something we believe to be true."

An epistemological assumption is a belief in the reliability and validity of the knowledge discovered during the research. Henning et al., (2007:15) describes *epistemology* as a term that is derived from the word "episteme" which is the Greek term for 'knowledge'. Willig (2001:2) explains *epistemology* as "a branch of philosophy concerned with the theory of knowledge. It attempts to provide answers to the question, 'How, and what, can we know?' This involves thinking about the nature of knowledge itself, about its scope and about the validity and reliability of claims to knowledge." Before research is conducted, I must first identify the aims and objectives of my study and be able to justify my choices. I must have clarity about the knowledge that I seek and the kinds of knowledge that I might possibly discover. I, therefore, need to adopt an epistemological position. The epistemological position adopted will guide the choice of the research methodologies used to gather data for my study. Qualitative or quantitative data collection methods or a combination of both may be used.

'Ontology' refers to how researchers view reality. Willig (2001:13) describes two different ontological positions namely, realist and relativist. The author explains that the realist view of reality pertains to cause and effect while the relativist view questions the "out-there-ness of the world". For this study, my ontological position will be that of a realist, viewing the impact of implementing change in the way teachers teach and learners acquire number concept.

'Axiology' is a defining characteristic of action research and "... is derived from two Greek roots, *axios* (worth or value) and *logos* (logic or theory); it means the theory of value (Pine, 2009:70)." 'Axiology' in my study will answer the question: What is the value of my research?

3.3.2 Situating action research in a research paradigm

The word paradigm comes from the Greek word, *paradeigma,* which means plan, model or pattern. The purpose of placing my research in a particular paradigm is highlighted by the following extract from Pine (2009:63).

> Paradigms provide an overarching conceptual view as well as a social and cultural framework for doing research, shape how we understand ourselves, determine what counts as valuable and

legitimate scientific knowledge, and define the experiences that can legitimately lead to knowledge and the kinds of knowledge that are produced .

To position my research in an epistemological framework, the case study has to be placed in a paradigm or plan that will define how the knowledge is produced and interpreted. Here follows a brief discussion of three different research paradigms, namely: the positivist paradigm, the interpretivist paradigm and the paradigm of praxis.

3.3.2.1 Positivist paradigm

I find the characteristics mentioned by Henning et al., (2007:17), Koshy (2006:85) and Pine (2009:13) quite useful in understanding the positivist paradigm:

- The positivist framework searches for the truth and attempts to prove it through empirical research methods.
- There is a cause and effect relationship between the data collected and any changes implemented.
- In a positivist paradigm large amounts of data may be collected utilising a survey. The data is then analysed and generalised conclusions are made.
- Data collected in a positive paradigm may be utilised purely for descriptive purposes, explanations or predictions.
- Utilising the positivist paradigm is not appropriate where the data includes reflections and emotions of the subjects.

My study utilises interaction with human subjects and includes reflections upon the data collected as well as the reflections of my respondents. Positivism would therefore not have been an appropriate paradigm.

3.3.2.2 Interpretivist paradigm

The interpretivist or constructivist paradigm as it is sometimes referred to, differs from the positivist paradigm in that it advocates that human thought cannot be free from influence by human emotion. There is therefore no absolute truth or absolute reality. Truth and reality are subject to change as influenced by the impact of emotion on the interpretation of the knowledge (Kincheloe, 2003:49).

While the interpretivist paradigm allows for reflection and the impact of emotion upon the interpretation of data, this paradigm would not have been appropriate for my study as my ontological position is realist, or cause and effect. The interpretivist paradigm does not allow for intervention to bring about change.

3.3.2.3 Paradigm of praxis

O' Brien (1998:6) states that "Praxis, a term used by Aristotle, is the art of acting upon the conditions one faces in order to change them". McNiff et al. (1998:8) defines 'praxis' as:

> "...informed committed action that gives rise to knowledge rather than just successful action. It is informed because other people's views are taken into account. It is committed and intentional in terms of values that have been examined and can be argued. It leads to knowledge from and about educational practice".

Praxis is the framework or paradigm that focuses and organises how the knowledge is collected, analysed and interpreted and how knowledge evolves and grows. I chose to conduct research within the paradigm of praxis as this viewpoint is ideal for use in the educational field and change is negotiated with the participants, respecting their input. This paradigm allows for human emotion interaction with data while allowing for change through the vehicle of action research.

3.3.3 What is action research?

I used action research and qualitative data collection methods to gather information about the teaching and learning of number concept, while conducting a case study in a grade 2 class. In order to understand how the data was collected it is necessary to first explain action research as a methodology.

O' Brien (1998:2) defines action research as the process by which "a group of people identifies a problem, does something to resolve it, sees how successful their efforts were, and, if not satisfied, tries again." This quote refers to the different individual cycles and processes within a cycle of action research and the repeated actions required by this method of research.

Greenwood and Levin (2005:54) state that: "Action research aims to solve pertinent problems in a given context through democratic inquiry in which professional researchers collaborate with local stakeholders to seek and enact solutions to problems of major importance to the stakeholders." This quote is an accurate reflection of how this research will be conducted.

Action research is a practical and systematic way to plan and implement continuous improvement in every educational practice. In order for change to occur, different cycles of action research have to take place. Each cycle is guided by the outcomes of the previous cycle. (CELT, 2003).

Action research can have many cycles. This form of research links "improvement in practice and increased knowledge and understanding" in a variety of action research cycles of activities (Winter, 1989:11). This diagram describes the different cycles in a visual manner.

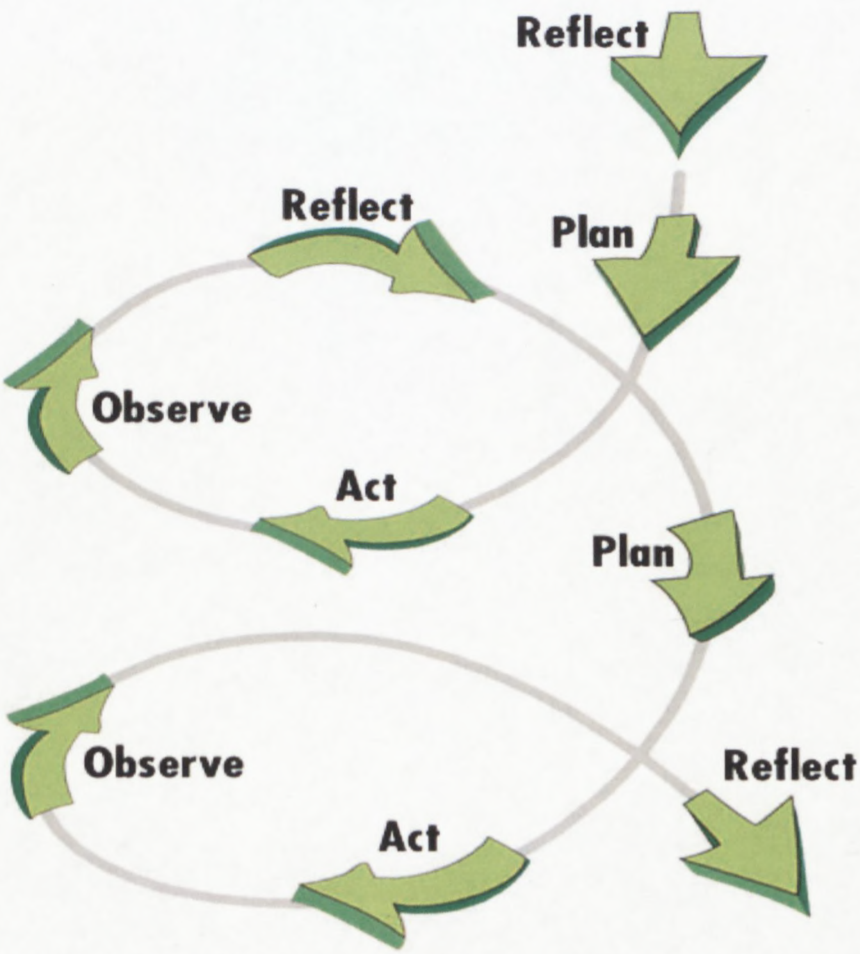


Figure 3.1: Action research cycle (CELT, 2003:1).

Ferrance (2000:15) explains the cyclical nature of action research by describing the different phases namely: "Identification of the problem area"; "collection and organisation of data"; "interpretation of data"; "action based on data"; and "reflection". The whole process then starts again at the beginning.

The figure below is a visual representation of the cyclical nature of action research as described by Ferrance.

Figure 3.2: Action research cycle (Ferrance, 2000:15).

O' Brien (1998:2), Ferrance (2000:1) and Kalmbach Phillips and Carr (2006:15) define action research as a scientific research process culminating in the systematic solving of practical problems through the process of intervention, during interaction with others, informed by theory and dependant on democratic and ethical principles. Research may be conducted in an educational context by a teacher to guide and change teaching practice within the classroom or school environment.

For the purpose of this study, action research is defined as an ongoing cyclical process of collecting and critically analysing data regarding the teaching and learning of number concept while simultaneously effecting positive change.

3.3.3.1 What is *not* action research?

In order to avoid confusion and eliminate misconceptions it is appropriate to state also what action research is not pertaining to be. Ferrance (2000:2) states that action research is not a literary-based library project where one makes inferences about a topic based on a review of literature. It is also not a method to identify what is wrong, but more a search for knowledge to improve. The author expounds by saying that action research is not about finding information on or about people or a specific topic looking for the perfect correct answer. Action research is about people endeavouring to improve their skills. Ferrance (2002:3) explains that action research is not about why we teach in a specific way, but how we can improve teaching practice to impact the learning of the learner in a positive manner.

I agree with Ferrance (2002) that action research is not a method to be used purely to identify what went wrong, but is about improving skills and knowledge. It is too easy to point finger at practitioners, which seems to be the current trend in South African Education, without assisting and improving the skills of our teachers. I will guard against allowing the data collection to denigrate into a fault-finding mission. Action research should not be about the critical pointing out of flaws, but an improvement of current practice.

3.3.3.2 What are the advantages of using action research?

There are many advantages for using action research as a methodology. Action research can be conducted within a specified situation or context. The researcher does not have to remain reserved and disconnected, but may participate in the study. Action research entails continuous evaluation and adaptations may be made as the study evolves. This type of research allows for theory to emerge from the research rather than following previously formed set theories. The study may conclude with "open-ended outcomes". Action research can allow the researcher "to bring a story to life" and can be a form of professional development for teachers to assist them to reflect upon and learn how to improve their own practice. Action research promotes collaborative learning and interaction among colleagues (Koshy, 2006: 21; Ferrance, 2000:13-14),

3.3.3.3 Why action research?

Based upon my experience as a learning support teacher which includes assisting learners with learning difficulties in mathematics and literacy, I have discovered that there are certain advantages of using action research to assist the class teacher as well as to improve my teaching practice.

My rationale for using action research as a methodology lies in the nature of my study, conducting research in the field of education, and my objective to collect information to bring about positive change in the area of the development of number concept.

As a learning support teacher in the Manenberg area I would like to improve not only my own practice, but assist other teachers and learners in the area of number concept development to improve the numeracy achievement of the learners at the two schools where I am currently teaching. Action research is the appropriate vehicle to realise this quest. My research has been conducted in the area of number concept development. The 'how I come to know' (knowledge), has been answered by the implementation of the action research method and more specifically by conducting a case study. Action research is the methodology that allows for the action and changing of knowledge in the framework of praxis.

Action research further allows for the gathering of data to provide a background source of knowledge for further study in which my aim is to develop a number concept intervention programme for teacher training.

3.3.3.4 Action research: A historical perspective

To allow for a better understanding of action research it is also necessary to explore the historical context and where this methodology originated.

In literature on action research from authors such as Adendorff (2007:37), O' Brien (1998:12), Ferrance (2000:7) and Smith (2007:2), Kurt Lewin, a German social psychologist, is credited as the person who first used the term 'action research'. Lewin (1947: 35) describes action research as "research which will help the practitioner". He sets the prerequisites that there have to be objective standards of achievement against which performance can be measured and that the researcher should know the context in which research is conducted. Lewin (1947: 41) explains the research cycle as follows: The first step to action research should be "broad fact-finding" followed by planning and implementing change, diagnosis and re-diagnosis. The following diagram constructed by Smith (2007:2) illustrates Lewin's cycle of action research.

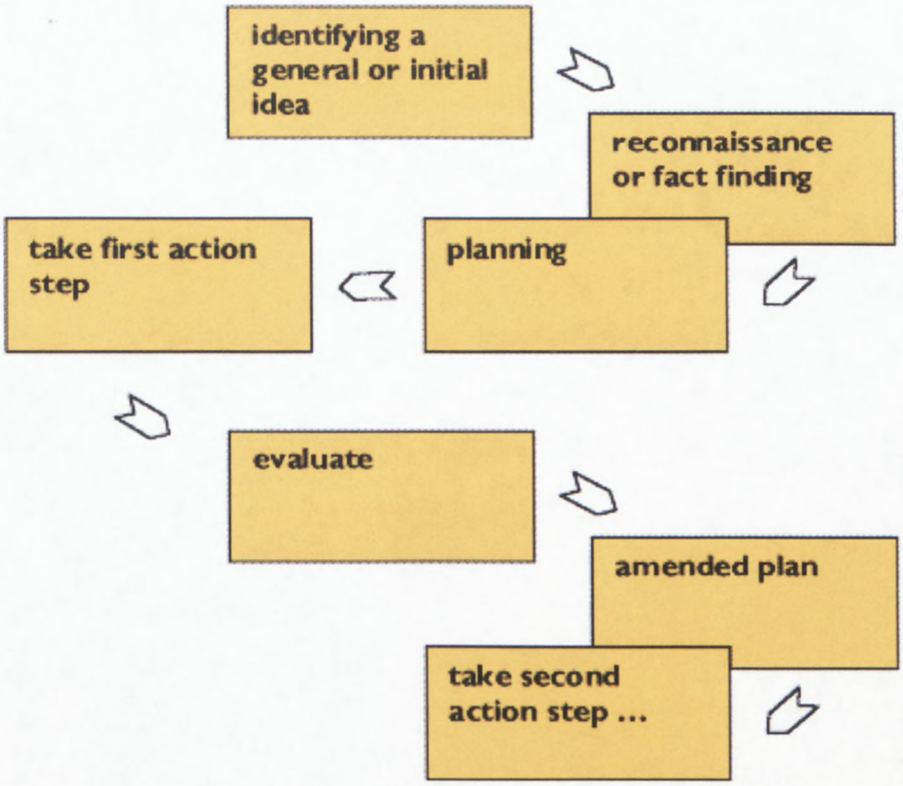


Figure 3.3: Lewin's cycle of action research (Smith 2007:2).

Figure 3.3 above illustrates the cyclical nature of action research and the steps that the researcher who conducts action research should implement. Lewin proposed that action research could be a continuation of steps starting with the original problem and fact-finding evolving into trying to find solutions and refining the solutions until the problem is solved.

Stephen Corey is also mentioned during the 1940's in relation to the development of action research (Johnson, 1993:1; Adendorff, 2007:37 & Ferrance, 2000:7). Corey, who lectured at the Teachers' College at Columbia University, was one of the first to use action research methods to conduct research in the field of education. He believed that action research together with the application of information would bring about change in education. Lewin focussed more on the practitioner in the field conducting research to bring about change and Corey was more involved with the generation of knowledge through the testing of hypothesis and encouraging the use of action research as legitimate in education (Adendorff, 2007: 37).

My concept of action research includes a combination of Lewin and Corey's ideas as discussed above. I will focus on the practitioner in the field conducting research to bring about change in the teaching and learning of number concept while collecting data to develop a number concept intervention programme as part of further studies.

3.3.3.5 Principles of action research

Winter (1989:35-67) identified six principles for the implementation of action research. The six principles are part of a cohesive approach and cannot be viewed separately. They are inter-dependant and incorporate one another. Each of these principles will now be discussed briefly.

The first principle is referred to as reflexive critique. Winter (1989:41) explains the concept of reflexivity as follows:

> "'Re-flexive' means, literally, 'bent back'. A reflexive judgment is inevitably bent back into the speaker's subjective system of meanings, but creates an illusory straight line which suggest that the judgment is an objective description of a reality external to the speaker."

This means that the readers of my study should interpret my words about the teaching and learning of number concept within the context of their previous experiences and not just as a literal understanding of the meaning of the words used.

The principle of reflexive critique in action research has three steps. In step one, data will be collected utilising a variety of strategies and tools. This data will be written down as field notes, journals, interview transcripts, etc. In step two, the reflexive basis of this collected data will be specified so that in step three, the claims made during interpretation may be changed into questions that will lead to possible alternative interpretations other than the norm (Winter, 1989:43).

One has to have an understanding of the meaning of the concept 'dialectics' in order to understand the second principle of dialectic critique. Winter (1989:46) defines 'dialectics' as "... a general theory of the nature of reality and of the process of understanding reality, yet its original Greek meaning is 'the art of discussion". Dialectic critique links to reflexive critique in "...that we can experience reality only by means of our competent participation in the complex structures of language". Dialectic critique encompasses the identification of relationships between observed activities or happenings which might be separate, but have unity. While the activities observed might have certain similarities, the researcher should also investigate and discuss that which makes them different from one another (Winter, 1989:46-47).

The third principle of collaborative resource speaks to the relationships the practitioner action-researchers have with their respondents. The action-researchers become part of the research process.

> 'Collaboration' here is intended to mean: *everyone's* point of view will be taken as a contribution to resources for understanding; *no-one's* point of view will be taken as the final understanding as to what all the other points of view *really* mean (Winter, 1989:56).

The principle of risk flows from the previous three principles discussed. "The principle is that initiators of research must put themselves 'at risk' through the process of investigation". The action researcher wants to bring about change and must make decisions based upon data collected to initiate this change. This involves risk-taking in that the researcher must anticipate what will transpire if certain changes are made to the *status quo* (Winter, 1989:60).

Principle five, plural structure, refers to the complicated action research process that seeks differences, similarities, initiating change, looking at different possibilities and asking questions. Winter (1989:62) states that this "... dialectical, reflexive, questioning, collaborative form of inquiry will create a 'plural structure', consisting of various accounts and various critiques of those accounts, and ending not with conclusions (intended to be 'convincing') but with questions and possibilities (intended to be 'relevant' in various ways for different readers).

Principle six incorporates theory, practice and transformation. Theory and practice are not two separate units, but interact, are inter-dependent and complement each other in the process of transformation. The action researcher is involved in practical activities, collecting data through observation, interviews and questionnaires. The action researcher is at the same time a person interacting with other people. This involvement as a person in practical activities takes place against the background of theoretical understanding, specialist professional knowledge and common sense (Winter, 1989:66).

> "It is this final argument, that theory and practice *need* each other and thus comprise mutually indispensable phases of a unified change process, which presents the strongest case for practitioner action-research..." (Winter, 1989:67).

3.3.3.6 Different approaches to action research

In order to give the reader an idea of where my research fits in, and in an effort to indicate towards which type of action research my research leans, it is necessary to discuss briefly the following types of action research as described in research literature: traditional, contextual, radical and educational research.

Traditional action research developed from Lewin's work within organisations. His work includes concepts and practises used in the management of labour relations. This form of action research is conservative and supports the *status quo* regarding to power structures within an organisation (O' Brien 1998:13).

Contextual action research is also referred to as action learning and stemmed from Trist's work on relationships between organisations. All participants take part to effect change through consensus.

A third form of action research, namely radical action research, has its roots in Marxism. Radical action research strives to correct power imbalances and social transformation (O' Brien, 1998:13).

Of all the different approaches to action research, educational research describes best what my study is about. Educational research developed from the educational theories and writings of John Dewey. Dewey believed that educators should become involved in problem-solving in the community and not just be curriculum and school orientated problem-solvers (O' Brien, 1998:13). While I agree with O' Brien that the community and society play a role in the academic progress of learners, for the purpose of this study the focus areas are the factors pertaining to the teaching and learning of number concept and not factors impacting from the community.

My research has been conducted in the field of education. Ferrance (2000: 5) identifies four different approaches to action research that could be conducted in the field of education. These four approaches to action research are summarised in table 3.1.

Table 3.1: Approaches to action research (Ferrance: 2000:6).

	Individual teacher research	Collaborative action research	School-wide action research	District-wide action research
Focus	Single classroom issue	Single classroom of several classrooms with common issue	School issue, problem, or area of collective interest	District issue Organizational structures
Possible support needed	Coach/mentor Access to technology Assistance with data organization and analysis	Substitute teachers Release time Close link with administrators	School commitment Leadership Communication External partners	District commitment Facilitator Recorder Communication External partners
Potential impact	Curriculum Instruction Assessment	Curriculum Instruction Assessment Policy	Potential to impact school restructuring and change Policy Parent involvement Evaluation of programs	Allocation of resources Professional development activities Organizational structures Policy
Side effects	Practice informed by data Information not always shared	Improved collegiality Formation of partnerships	Improved collegiality, collaboration, and communication Team building Disagreements on process	Improved collegiality, collaboration, and communication Team building Disagreements on process Shared vision

Collaborative action research has been chosen as the methodology to collect and interpret data for my study. My problem statement is that learners in the school where I teach fare badly in mathematics because they lack number concept. The focus is therefore a single grade 2 classroom out of the three grade 2 classrooms that have common issues regarding the teaching and learning of number concept. I received support from my supervisors at CPUT, the officials at WCED and the principal, governing body and grade 2 class educator of the school that has been identified as the designated site of research. The study could have a possible impact upon how the curriculum is interpreted, teaching practice and methodology, assessment and policy regarding the development of basic number concept. In table 3.1 Ferrance (2000:6) refers to “improved collegiality” and “formation of partnerships” as possible side effects. The words “side effects” have negative connotations. “Improved collegiality” and the “formation of partnerships” could be a positive outcome of collaborative research as they could facilitate the advancing of individual as well as collective knowledge.

3.3.4 Conducting a case study

As previously mentioned, my action research project has been conducted in a case study format. It is therefore imperative that case study as a method to conduct research is discussed in detail. There are several definitions of case studies in the literature. The following definition outlines how my research was conducted.

> [A case study] “...refers to the collection and presentation of detailed information about a particular participant or small group, frequently including the accounts of subjects themselves. A form of qualitative descriptive research, the case study looks intensely at an individual or small participant pool, drawing conclusions only about that participant or group and only in that specific context. Researchers do not focus on the discovery of a universal, generalizable truth, nor do they typically look for cause-effect relationships; instead, emphasis is placed on exploration and description” (Becker et al., 2005:2).

My role in the case study was initially that of observer exploring how the teacher taught and how the learners developed number concept within the context of the mathematics lesson in the classroom. Gradually my role developed to that of learner- and teacher support, facilitating and advising about the teaching and learning of number concept. The teacher remained at all times responsible for the control of the class as well as the preparation and teaching of the mathematics lesson. During the second cycle of action research, the teacher and I were able to reflect upon the whole process and implement other changes to benefit her teaching of number concept.

In pursuit of a rationale to use the case study approach, I was further motivated by the advantages of using this approach as discussed by Pine (2009:213-214) and Koshy (2006:106-107). The authors describe the following advantages of using the case study approach:

- The data of a case study is based in reality.
- Case studies let us take a broad view of one occurrence and apply or compare it to another occurrence. The strength of a case study is in the detail and density of the data collected.

- A collection of case studies about the same topic with the same types of conclusions could be open to further elucidation of data collected in future studies
- Case studies contribute to action taken. Their conclusions and recommendations may be directly interpreted and implemented.
- Case study data is very accessible. More so than the data from other research reports.

3.3.4.1 Case study approaches

With a view to the more meaningful positioning of this research, I explored different case study approaches. Pine (2009:212) identifies three major case study approaches, namely: appreciative inquiry, cultural inquiry and descriptive review. Below is a table with a short description of each of these approaches to provide an overview of how a case study could be managed in the field of education utilising the descriptions provided by Pine (2009:218-233).

Table 3.2: Case study approaches (Pine, 2009:218-233).

Appreciative inquiry	Cultural inquiry	Descriptive review
Focuses on identifying best practice to support change in the system.	Concentrates on the ever changing culture of people as present in for example multicultural classrooms.	Describes one specific learner.
Uses interviews to gather information	Information is collected asking questions of a cultural nature, determining the cultural context of an occurrence or situation	Uses observations, assessments, conversations and documents to gather data about a specific learner.
Concentrates on the individual, the curriculum, the school or a specific programme	Focuses on the cultural diversity of a specific setting or occurrence such as in a classroom, the school or the playground.	Describes the circumstances, observations, assessments and conversations of a specific learner in different settings

While comparing the three case study approaches, I deemed the appreciative inquiry approach to be the most appropriate manner in which to conduct my case study. The appreciative inquiry approach concentrates on the identification and sharing of best practice, gathering data through interviews and has a wide focus area from the individual to the whole school.

This case study is grounded in the appreciative approach. During the observation period, I identified the best practice in the teaching and learning of number concept that was implemented in the grade 2 class. Throughout the second action research cycle, the teacher and I built upon the good practice, expanding and improving how number concept is taught and learnt. Observation, an interview and a questionnaire were used to gather information. More information about why these methods were chosen to gather the data will be discussed later in this chapter. The study focuses on an individual teacher in an identified school within the specific area of number concept in mathematics

3.3.5 The task of the researcher

I experienced the task of the action researcher as a very complicated and intricate dance between building relationships with the respondents, gathering information and remaining objective about the data collected. Bogdan and Biklen (1998:73-105) provide a thorough explanation on the task of the action researcher and how to conduct fieldwork.

3.3.5.1 Gaining access

The first task of the action researcher should be to gain permission to conduct research (Bogdan & Biklen, 1998:74). Some of the advantages could be that the researcher could be allowed a reprieve from her normal duties as teacher to a full class and given the opportunity to conduct research in this available time. Having permission to conduct research also facilitates access for interviews with teachers, members of the school's board of governors and the principal as well as departmental officials. Openly conducting research allows for collaboration with other professionals and the sharing of knowledge.

While permission to conduct research must be obtained from the powers higher up, the researcher would be well served to first seek compliance from the respondents where research would be conducted (Bogdan and Biklen, 1998:75). This will lay the groundwork for future collaboration and the building of relationships. Consultation with the respondents while informing them about your intended research could be beneficial for future trust relationships and make them feel a part of the process at the very beginning.

Trust and honesty between the researcher and the respondents are essential for conducting collaborative action research (Pine, 2009:131). Promises of confidentiality and anonymity further validate that trust (McNiff et al., 1998:34). Trust relationships are ever- changing and can be affected by a simple comment, misunderstanding or decision that contravenes what one person is expecting from another in the relationship (Tschannen-Moran & Hoy, 1998:335).

The first few days of fieldwork sets the stage for future collaboration (Bogdan & Biklen, 1998:81). The researcher should ask someone to introduce her and inform the group as to what she will be doing there. The researcher should be friendly and remain passive, not asking too many questions, while remaining enthusiastic about her study and what she is learning. Gradually as the research progresses, the researcher can participate more.

The level or extent of the participation can become another area of concern. It is extremely difficult to balance participation and observation. The researcher may also not dominate and should be careful of criticism of the leader and members of the group. It is important to build the right rapport with the respondents as it allows for better data collection (Bogdan & Biklen, 1998:82).

The researcher should be aware that her own feelings and prejudices can be possible sources of bias against the respondents. It is important not to be drawn into any negative feelings that the respondents might have about their situations, but to acknowledge and reflect upon these feelings (Bogdan & Biklen, 1998:91).

I submitted a proposal to conduct research to the Higher Degrees Committee of the Cape Peninsula University of Technology and was granted permission to conduct research in the area of number sense development. Application for permission from the WCED to conduct research at an identified school in the Manenberg area was granted (See appendices A and B). I approached the principal of the identified school and made a written request to the governing body to be allowed to conduct research at this site. The request was approved verbally. Over a period of three weeks, I negotiated with the identified class teacher for access to conduct action research in the grade 2 classroom. The class teacher was very hesitant and unsure initially, but gave permission and a verbal agreement was negotiated (see below). The parents of the learners in the class were informed about the study with written and verbal communication. I spoke to the parents and answered questions at a parent-teacher conference.

The following strategies were negotiated with the class teacher prior to the initiation of the research period:

- I would initially only act as observer and later expand my involvement as participant observer.

- The teacher would assist me by identifying six focus group learners in need of intervention in the development of number sense.
- The class teacher would remain in control of the class and be responsible for all planning and preparation.
- I offered assistance with the preparing of and provision of LTSM.
- Permission was negotiated to make audio and video recordings.
- Photographs may be taken of the learners' work, the classroom and LTSM, but not of the teacher and learners.
- All participants would remain anonymous and confidentiality was guaranteed.
- The class teacher would give consent that she agrees with the information included in **Chapter Four** of the dissertation and may choose to have specific information excluded.
- Video footage would only be viewed by my supervisors and me.
- Audio- recordings of any interviews would be transcribed and attached to the dissertation.
- I would attend the class during mathematics lessons three mornings per week.

This agreement was the start of the building of a trust relationship with the class teacher and opened communication between the teacher and me.

3.3.5.2 Determining the research site

In an educational case study, the researcher often chooses an organisation such as a school and then focuses on a specific aspect for instance a special programme, an area of the curriculum, a particular class or a certain teacher. Researchers may experience difficulty in whether to choose one site or multisite or multi-subject studies (Bogdan & Biklen, 1998:54-55).

Once the site of the research and the focus of the study have been decided, there is still the issue of what time of the year and what time of the day to consider for the observational sessions. Choosing a specific focus area in a particular organisation can be artificial and the researcher should always try to relate the focus point to the context of the background (Bogdan & Biklen, 1998:55).

Manenberg was chosen as the site of research as most of the schools in the area have been identified by the WCED as schools that have fared poorly in the national systemic assessment of 2008 and 2009. I am currently teaching at both a single medium (English only) and dual medium school (English and Afrikaans). I chose to conduct research in an English medium class. The study therefore had to be conducted at the dual medium school. I was trained in Foundation Phase teaching and learning support and therefore chose to conduct research in the Foundation Phase area of the Primary School. The grade 2 class was chosen for the following reasons.

- There is currently only one English medium grade 2 class in the school.
- The teacher of the grade 2 class is a head of department (HOD) as well as the co-ordinator of the Institution Level Support Team (ILST). She is in an ideal position to pass information along to other teachers who work with her. This is an added benefit to the study as information regarding effective ways to develop number concept will be shared.

3.3.5.3 Determining the focus group

Sampling in a case study can take on different forms. Some case studies focus upon one individual at a time, others focus on groups of participants. The observational strategy of the researcher often determines the size of a particular sample. With a larger sample the researcher is more likely to be a participant observer as opposed to observing single participants in their natural setting (Cohen & Manion, 1994:123).

The sample of the case study during the first cycle of action research conducted in 2009 consisted of the teacher and 43 learners in the English grade 2 class. In the second cycle of action research conducted in 2010 (i.e. a year later), the sample consisted of the same teacher and 47 different English grade 2 learners.

The focus of the action research in cycle one was 6 learners who had been identified by the class teacher as learners in need of intervention in the area of the teaching and learning of mathematics in the grade 2 classroom. The class teacher identified these learners utilising a baseline assessment tool provided to the schools by the National Department of Education in South Africa. This data was confirmed by further observation and formal assessment tasks developed by the class teacher to assess the learning of the mathematics in the classroom. I did not conduct any testing of the learners prior to commencing action research or after conclusion of the research. The focus of the research was not the efficacy of the teacher's teaching strategies, but how the development of number concept was facilitated and how the learners acquired number concept. The focus group of learners completed assessments compiled by the class teacher as part of the mathematics assessment programme of the school during and after the action research period.

There was no focus group in action research cycle two as the focus was more upon the teaching practice of the class teacher and less on how specific learners acquired number concept.

3.3.5.4 Why a focus group?

The utilisation of a focus group during the observation period in the first action research cycle in the classroom had more than one purpose. The research was conducted through action research while utilising a case study approach. This allowed for the richer collection of data as observation was restricted to six learners as opposed to 43. The focus group consisted of learners who experienced difficulty with mathematics and therefore needed more assistance than the rest of the class with the development of number concept which allowed for more intensive data collection. I was able to spend individual time with each of the learners in the focus group to ascertain which methods worked best for each of them and for the group as a whole.

3.3.6 Data collection strategies and tools

Both case study and action research advocate the use of the data production and collection strategies as discussed below. I was further guided by the qualitative research methods outlined in research conducted by Le Grange (2001:80-84) and Adendorff (2007:41-50).

3.3.6.1 Participatory observation

'Participatory observation' is defined as "participating in the actions of the people in the research setting and getting to know their ways of doing very well" (Henning, 2007:82-85). The difference between participatory and standardised observation is that in standardised observation the researcher will use an observation schedule in which she will place what she has observed. In contrast, the researcher will write field notes of her observations of events as well her impressions during a participatory observation session. While conducting practitioner research, the researcher may get involved in the teaching of the learners while observing how they learn in an educational setting.

3.3.6.2 Field notes and journals

Field notes, the keeping of a research journal and video recordings are all methods to record observations which I used extensively.

The advantage of keeping field notes of observations during case studies is that it serves as a reminder of events (McNiff, 1994:77). A research journal is a record of the events observed by the researcher as well as reflection upon those events. Field notes should be transcribed into the journal at regular intervals (McNiff et al., 1998:7).

I observed the mathematics lessons for an hour three times a week initially as non- participant observer, an at a later stage as teacher assistant (participant observer). During the observation, detailed field notes were made and later transcribed in a research journal. I observed teaching practice, educator-learner interaction, learner-learner interaction as well as the utilisation of resources.

3.3.6.3 Questionnaires

Even though it is not usual to utilise an open-ended questionnaire as a data collection tool with only one respondent, namely the teacher, I have chosen to use this instrument for the following reasons:

A questionnaire is less threatening and allows for distance between the researcher and the teacher eliminating some of the dynamics of the previously discussed relationship between myself and the teacher. Sensitive questions regarding the teacher's qualifications and experience are asked which she might feel more confident to answer in an anonymous setting rather than during direct contact with the researcher. The teacher will be allowed to leave sensitive questions unanswered in the questionnaire which she may feel intimidated by and pressured to answer during an interview.

The questionnaire will familiarise the teacher with the topic of my research and provide a less threatening introduction to the action research case study where the development of a relationship of trust between the teacher and I is essential for the data production to be successful.

I found Koshy's ideas (2006:87) useful in the utilisation of the questionnaire as a data collection tool. He advises the researcher to use questionnaires at the start of a project as it assists the researcher to collect a variety of different data that can be explored further later in the study. The questionnaire can also be used as a baseline reflecting the respondent's knowledge, values and attitudes prior to intervention, and could also form the basis of future questions that can be asked during interviews designed to collect data.

There are many advantages to using a questionnaire as a tool to collect data during research. Questionnaires assist with the effortless collection of background information that can provide a baseline to the research study and the collection of a substantial amount of information in a relatively short time. Questionnaires present data or information that can be followed up and allow for the initial collection of information regarding values, attitudes and perceptions of the respondents (Koshy, .2006:89)

3.3.6.4 Interviews: Formal and informal

In the data production period of my research I utilised both a formal interview as well as numerous informal discussions with the teacher as strategies to collect data. I found the informal discussions yielded richer data as the teacher felt less threatened. No informal discussions were audio-recorded and the teacher therefore participated more freely in the discussions and was less inhibited to share. Bogdan and Biklen (1998:98) also advocate the use of interviews to collect data in a case study.

The main goal of interviews is to gather data which will be more informative than the data gathered through the utilisation of questionnaires (Koshy, 2006:92). I agree with Koshy that the data were more informative as the format of the informal discussions allowed the teacher to freely express her views in discussion format rather than to just answer questions. Koshy (2006:92) recommends that the interviewer start with a simple question followed by open-ended questions that will allow for the collection of richer data.

There are many advantages to using interviews as a means of collecting data while conducting research. An interview invites the subject to be part of the study. Interviews are personal, inviting and can provide an informal relaxed atmosphere in which to collect data. This positions the subject on the platform of the one who has the knowledge and the researcher as the one who is searching for knowledge. Interviews show the subjects that you value and respect their knowledge and encourage them to share their own ideas and observations. This can provide unanticipated and informative viewpoints. Interview transcripts are authoritative evidence of data and assist with the drawing of conclusions (Koshy, 2006:93; Bogdan & Biklen,.1998:98)

The participant teacher and I had informal discussions where we reflected on teaching practice as well as possible interventions and resources. These discussions formed an important part of the cyclical nature of action research as they allowed for discussion on the effectiveness of specific number concept development strategies and how to improve teaching practice. The discussions further served as an opportunity to clarify data collected during observation sessions.

3.3.6.5 Video recordings

I used a life-cam device to record some of the sessions. A life-cam is a video device that records video footage directly on to the hard drive of a computer or laptop. The footage served merely as a support to observations made and afforded me the opportunity to gather more in-depth information. Recording video footage has some ethical implications regarding anonymity and informed consent which was already discussed as part of ethical considerations (see **Chapter One**).

There are many advantages of using video recordings to record activities in the context of a classroom for research purposes. Video recordings are more accurate than mere observation and can provide a better account of the respondent's attitudes and perceptions. It is a permanent record of events that can be re-visited and simplify the sharing of information with other researchers. The video recordings assist with data analysis and the communication of findings as they can be reviewed and experienced first hand by researchers who were not present at the site of research. When taken over a period of time, video recordings can clearly show the changes that occurred before and during intervention. Video recordings often produce a great deal of discussion and sharing of ideas (Koshy, 2006:103-104).

3.3.6.6 Audio recordings

Koshy (2006:92) advocates the use of audio recordings during interviews, because it is impossible for the researcher to fully concentrate on conducting the interview while trying to write down everything that is being said. Transcripts of the interviews will also be helpful when the researcher analyses the data collected. The transcript of the interview is a powerful source of evidence.

An audio recording of the formal interview with the class teacher was made to allow for richer data to be collected. The transcription of the interview is attached as appendix F.

3.3.6.7 Photographs

Bogdan and Biklen (1998:151) point out that in "educational researchers' quest for understanding photos are not answers, but tools to pursue them." The authors advocate that researchers not just take photographs for the sake of taking them, but that the taking of photos should have a specific purpose. The researcher should first ascertain the purpose and what the photograph should contain before randomly taking photographs. In order for the photograph to be published "...it is imperative that each recognizable individual in each picture sign a release that gives permission to publish his or her picture. Parents or guardians must sign one for minors" (Bogdan & Biklen, 1998:152). The authors advocate that permission be sought at the beginning of the study as it could be time-consuming and could impact on data in photographs not being able to be used in the study.

Photographs of the learner's work as well as the classroom layout and LTSM used have been taken. No prior permission was necessary as no photographs were taken of any of the participants in the study. The class teacher gave verbal permission for the taking of photographs of her classroom and the learner's work. I assured her that anonymity and confidentiality would be observed and that at no time would the location where the photographs were taken be made public knowledge.

3.4 Data analysis

Bogdan and Biklen (1998:157) define data analysis as "...the process of systematically searching and arranging the interview transcripts, field notes, and other materials that you accumulate to increase your own understanding of them and to enable you to present what you have discovered to others. Analysis involves working with data, organising it, breaking it down, synthesising it, searching for patterns, discovering what is important and what is to be learned, and deciding what you will tell others."

"Discourse analysis" will be used as a tool to make meaning of the data produced during data collection in the case study. Discourse analysis is similar to coding and categorising used in other forms of data analysis in that data is read to find clues of "units of meaning". The differences lies in that "Discourse analysis is ...about both meaning and structure of and in language as analysis platform to move to understanding social action and the human condition in other data as well" (Henning, 2005:122). Discursive data units of meaning in the use and understanding of conceptual language will be identified in the process of making meaning by both the teacher and the learners during interaction with resources and discovery while developing number concept.

3.5 Validity, credibility and reliability

Validity, credibility and reliability of data generated in an action research case study are supported by the rigour with which the research was conducted.

Pine (2009:85-89) identifies twelve criteria for validity in action research. The author states that different aspects of the validity criteria will be used depending on the reasons for conducting research and the context in which research is conducted. The criteria will be discussed briefly below.

- Catalytic validity questions the transformation of reality. It challenges the changes in the perceptions, actions and situations created by the researchers.
- Consequential validity spells out the consequences and thus value added by the research. It encompasses fairness, usefulness and meaningfulness of the research.
- Democratic validity investigates the role of all the stakeholders in the research and to what extend collaboration took place. It includes respect for all opinions and questions the equity and fairness of who benefits from the research.
- Ethical validity speaks to issues of confidentiality, permission to conduct research, truthfulness and privacy of respondents.
- Interpersonal validity includes the building of trust and personal relationships between the researchers and respondents. It interrogates the effectiveness of communication between the researchers and the respondents.

- Outcome validity queries the authenticity and value of the findings of the study. The quality of knowledge and the value added to educational practice are examined.
- Process validity speaks as to how the research process was conducted to ensure validity of the information. It includes the use of the correct methodology, the choice of data collection strategies and tools, the utilisation of a variety of sources as well as the design of the study to answer the research problems.
- Public validity probes to what extent the results of the study have been made public and have been discussed with other researchers. This includes the accessibility and manner in which the data was communicated so that others could understand it.
- Recursive validity is synonymous with the cyclical nature of action research. It includes the study of knowledge or the reality, reflection, change and the adaptation of action leading back to the study of how the change impacted on the knowledge. It questions how changes were communicated to the respondents, how action brought about change and how participants and researchers were included in the process of change.
- Social justice validity checks whether the research has addressed issues of equity, the cultural and gender differences between participants as well as access for participants who are disabled.
- Values validity incorporates the researchers' stance towards their own beliefs, intentions and values. It questions whether the researchers have disclosed their own preconceptions as well as the honesty and integrity with which the researchers have conducted their research.

"Validity, credibility and reliability in action research are measured by the willingness of local stakeholders to act on the results of the action research,...The core validity claim centers on the workability of the actual social change activity engaged in, and the test is whether or not the actual solution to a problem arrived at solves the problem" (Greenwood & Levin, 2005:54). The findings of the data analysis will determine how valid, credible and reliable this research is.

Validity will further be ensured through triangulation of the data collected using different instruments. Trustworthiness and rigour of observations will be supported by video and photographic evidence. Audio-recordings will ensure the validity and rigour of data collected during the interview.

Ethical validity will be supported in that the confidentiality of all data collected is guaranteed. The participant teacher will grant final consent regarding the publication of information contained in **Chapter Four** of the thesis.

3.6 Timeframe

Timeframe	Activity
• April 2009	• Approach research site for permission to conduct research
• June 2009	• Proposal accepted
• July 2009	• Permission from WCED to conduct research granted
• July – September 2009	• Conducted first observation action research cycle
• October 2009	• WCED granted request to extend research period
• January – March 2010	• Conducted second observation action research cycle
• April 2010 – December 2012	• Planning, preparation and writing of thesis

3.7 Conclusion

This chapter provides an overview of the aims and objectives of my research and my quest to position my research in an epistemological, ontological and axiological position. This is followed by an attempt to ratify my choice of action research in praxis including case study as the correct methodological approach to collect, analyse and interpret data. Various data collection strategies and methods are discussed.

Chapter Four includes a description of the research site, the participants and the context of the study. The various action research cycles implemented to bring about change in the teaching and learning of number concept in the grade 2 classroom are discussed in detail.

CHAPTER FOUR

ACTION RESEARCH: OBSERVATIONS, CHANGES AND OUTCOMES

4.1 Introduction

In this chapter, action research and how the data were collected will be discussed to provide a background to the research. The research questions are restated and the data analysis is presented in a narrative format and discussed utilising the different phases in an action research cycle as well as the case study format.

Action research differs from other research in that data collected during observation is utilised to implement changes in practice. During the different action research cycles, I reflected upon observations made, changes implemented by the teacher as well as successes and failures of the changes implemented. These reflections were focussed upon the teaching and learning of number concept development during mathematics lessons.

As a researcher, I had to critically observe the teaching and learning of number concept. I endeavoured not to judge the teacher and to encourage her to embrace the suggested changes. I was not always successful in totally convincing the teacher to my point of view and the implemented changes were a process of ongoing negotiation. As the trust relationship between the teacher and I developed, the teacher became more open to the changes and embraced her own professional development with enthusiasm.

The approach to the analysis of the data has already been discussed in **Chapter Three** of this dissertation. Observations and background information regarding the participants in this study will be explained and discussed. The teaching and learning of the super-ordinate and subordinate concepts of number sense will be critically examined and analysed.

4.2 Research questions

I will attempt to answer the following research questions during analysis of the data collected.

How do learners in a grade two class in Manenberg acquire number concept skills?

Which teaching strategies are currently used to support the acquisition of number concept skills in a grade two class in Manenberg?

4.3 Definition of number concept

The following definition explains what I expect from the learners in the grade 2 class in the area of number concept development.

> Number sense 'describes a cluster of ideas, such as the meaning of a number, ways of representing numbers, relationships among numbers, the relative magnitude of numbers, and skill in working with them.' Number sense is not a discrete set of skills to be taught for three weeks... or something that only those that are 'good at math' have. It is part of children's daily mathematical lives and slowly grows and develops over time" (Wilson Carboni, 2001:1).

The observation sessions were focussed on the ease with which learners used, understood and manipulated numbers to solve mathematical and everyday problems and the different teaching strategies implemented by the teacher to develop this number concept over a period of time.

4.4 Data analysis

As discussed in **Chapter Three**, data was collected during ongoing cycles of action research. Each cycle included the gathering of data, interpretation and implementation of change, evaluation and identification of the next problem. Discourse analysis was used to analyse the data collected. The data were coded into subsections such as planning, LTSM, classroom organisation and teaching strategies. The data analysis will be utilised to attempt to answer the two previously stated research questions and will ultimately result in a critical analysis of the teaching and learning of number concept in the Western Cape.

4.4.1 The school and environment

To provide context for this study, a brief description of the school building and surrounds must be included. The learners live in flats that have been organised into courts, backyard structures made of wood or sink or free standing houses. As discussed in **Chapter One**, the living conditions in the area of the school are very poor and poverty has a major impact on the lives of most of the learners in the area.

Most of the schools in the Manenberg area are within a one or two block radius from one another. The majority of the buildings consist of pre-fabricated structures with open passages. The schools have ample playgrounds, but struggle with the maintenance and upkeep of this as well as the buildings. During an informal discussion, the headmaster of the relevant school reported that the building was initially put up as a temporary structure to be replaced after five years. The building is now 35 years old. Most of the schools in the area have just been painted by the Department of Public Works, but broken windows, broken ceilings and inadequate lighting is the order of the day.

The following photographs are examples of schools in the area of the research site.

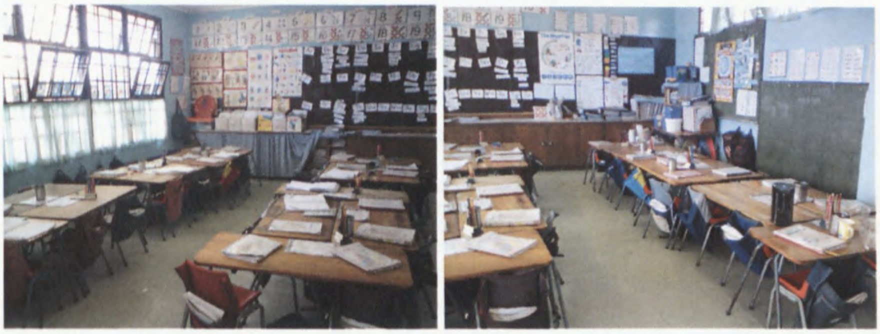
 

The results obtained by this research should be evaluated against the background of these social factors, although the impact thereof on the teaching and learning of number concept has not been researched in this study, as that was not the main focus.

4.4.2 The classroom

The classroom is part of a pre-fabricated building that was initially designed to house 25 to 30 learners per classroom (Headmaster, 2010). During the observation period in 2009, there were 43 learners in the class and in 2010, there were 47. It is extremely difficult to arrange seating so that the majority of the learners face the blackboard. There is very little space between tables, making it difficult to assist learners individually at tables. There is also limited space for the storing of books and resources as well as the learner's suitcases. Learners are often cramped together at the tables or on the mat. When the teacher was asked in the questionnaire which factors hampered her teaching, she indicated that there were too many learners in a class and that she would like to see the number reduced.

The following photographs depict the layout of a grade 2 classroom at the site of research.



This photo shows both halves of the same classroom. Note how the teacher has utilised space by grouping the learners, hanging their bags against the walls and the use of chair bags. The teacher has very little space to pack and store apparatus.

The Foundations for Learning (FfL) campaign 2008 – 2011 document, suggests specific LTSM to be on display in the classroom (South Africa, 2008:2). The teacher has the following wall charts for mathematics on display in her classroom: number charts with dot representations: 1-20; number and number names with pictures: 1-20; timetables chart; number lines depicting the four basic operations chart; 100 number chart; colours chart; months of the year; 3 D shapes chart; doubling and halving chart; number names – 10; digital time chart; different examples of types of number lines – 10 chart; length chart; number names in tens to one hundred and counting in 4's chart. The teacher has most of the resources as recommended by the FfL campaign 2008-2011 for mathematics (South Africa, 2008:17). What is lacking is sufficient apparatus to be used by individual learners while engaged in problem solving and basic operations.

There is also a Foundation Phase mathematics equipment kit supplied by the South African Department of Education in the classroom. This kit is shared by all twelve teachers in the Foundation Phase.

While there are a number of wall charts and wonderful mathematical equipment supplied by the school and the department, the number range of the charts do not comply with the number range in which grade 2 learner must work as prescribed by the National Curriculum statement for Mathematics (South Africa. NDE, 2002:21). There is also not enough counting equipment to have sufficient for the learner to use individually in a group on the mat.

4.4.3 The class teacher

As previously discussed in **chapter two,** the role of the teacher is critical in the development of number concept. Crucial factors that impact upon the teaching and learning of number concept are the on-going development of teacher's subject knowledge and knowledge of teaching strategies pertaining to the specific development of number concept. (Newman & Way, 2009:411).

> Teachers may be unaware of how to promote early number skills. Many teachers anticipate that as children enter school they have already acquired certain basic levels of mathematical development and are able to make connections and process basic number. They often teach accordingly, introducing number concepts that are frequently misunderstood placing a learner 'at risk' of failure, low progress or difficulty with learning (Newman & Way, 2009: 412).

The class teacher has ten years of teaching experience in the Foundation Phase, but is trained to teach in the Senior Phase. The first cycle of action research in 2009 was her second year of teaching in a grade 2 class. This contributed to her feelings of insecurity and her hesitance in initially allowing me to conduct research in her class. She is one of two Foundation Phase Head of Departments (HODs) at the school. The class teacher is also the co-ordinator of the Institution level support team (ILST). The ILST is the committee that promotes and coordinates learning support and intervention at the school.

During completion of the initial questionnaire, the class teacher omitted to answer questions relating to her qualifications, her understanding of number concept development and teaching strategies that she used to develop number concept. At a later stage during one of the informal discussion sessions, the teacher gave an indication that she was trained to teach at a high school or at senior primary level. She then informed me that she was concerned that her colleagues would question her knowledge and leadership position if this information was made known. In my opinion this contributed to her lack of confidence and hesitancy when approached to be a participant in this study.

The class teacher avoided completing questions on the questionnaire that related to how and if she reflected on her own practice and the strategies that she employed when experiencing difficulty in any aspect of her teaching. Questions relating to the experience of any difficulties within areas of the curriculum that deals with number concept development were also not answered.

Further information gained from the initial questionnaire disclosed by the teacher includes that she teaches mathematics for 1 hour a day, 7 hours per week. This is in line with the **minimum expectations** as suggested by the FfL campaign 2008 - 2011 in South Africa (South Africa, 2008:7).

4.4.4 The focus group learners

The six group three learners are seated on the front right side of the classroom. Learners R and Learner K are sitting with their backs to the board and are facing the back of the classroom. Learner L and Learner Z are seated on the right next to the window and have a reasonable view of the board. Learner M and Learner A are seated on the left side of the table and have to turn to look over their shoulders to view the board. The teacher normally writes the work on the far left side of the board. Most of the focus group learners do not have a clear view of the activity written on the board. The classroom is too small to accommodate the number of learners which necessitates that some learners have to sit with the backs to the board or look sideways over their shoulders.

4.4.4.1 Background information

The identification of the learners in the focus group has already been discussed in detail in **chapter three.**

In order to allow for a deeper understanding of the data collected, it is necessary to provide a short description of each of the learners in the focus group. These descriptions rely heavily on my observations and assumptions. I have also added brief descriptions of my observations about their number concept ability. The teaching and learning of the focus group learners will be discussed in more detail in **chapter five.**

No formal number concept assessments were conducted at the beginning of this research project as number concept encompasses an expansive variety of concepts and skills and assessment would have had to include all of these areas. A comprehensive assessment would have had a negative impact upon learners who were already experiencing difficulty in mathematics and number concept, impacting upon the outcome of assisting these learners to become more competent at mathematics in general and the development of their number concept specifically, during the action research process.

K is a boy who seemed to have the potential to succeed in mathematics, but did not reach this goal due to emotional difficulty. He displays constant emotional outbursts ranging from anger to sulking and non-participation in classroom activities. K is extremely attention seeking and responds well to praise. He will, however, not share this attention with anyone else in the group and I felt compelled to spend more time with him for the sake of peace in the classroom and the functioning of the rest of the group. This manipulative behaviour affects his academic progress adversely. K enjoys showing off and helping others in the group with their tasks. K is supposed to wear spectacles, but never has them on. His behaviour indicates a learner with possible attention deficit difficulties. K experiences difficulty with all areas of number concept taught, but was able to solve addition, halving and the money problems once allowed to work with concrete equipment. He very quickly lost interest during activities and had to be encouraged to complete tasks.

Learner A wears spectacles, has difficulty with visual focusing and has a very short concentration span. His behaviour and academic progress show that he lags behind developmentally. His parents are deeply concerned and very supportive of him. He spends most of the mathematics teaching time staring into space and just copying work from others and from the board. Learner A seems disinterested in school work and has developed some work avoidance tactics. It is my opinion that given more time and with the constant monitoring of his eyes that this learner will be able to grow and develop academically. He needed one-to- one assistance and did not master any of the number concepts taught during this time. It was recommended that Learner A spend more time in the same class in the following year. I again made some general observations about his progress during the second cycle of action research during the following year after he was allowed to spend more time in the grade 2 class. Learner A had grown in maturity and confidence and was mastering some of the basic number concepts such as the concept of addition. He no longer stared into space and made an effort to complete tasks and concentrate during the mathematics lessons.

R is a learner who has the potential to experience success in the field of mathematics. He is also prone to attention seeking behaviour, but to a lesser degree than K. He sometimes clashes with K and also presents with a short attention span and work avoidance tactics. R is left handed. One moment he is confident and the next unsure of how to solve the mathematical problems. R was absent from school for a number of the observation sessions and this contributed to his insecurity. R. has the understanding and is able to transfer knowledge and utilise abstract methods to solve problems such as halving and addition involving bigger numbers, but lacks some of the essential skills in number concept due to constant absenteeism.

M is a learner who has a short attention span and takes forever to complete tasks. She is the only girl in the group and acts as a 'mother' and peacemaker in the group. This is a work avoidance technique. M is easily distracted and struggles to understand even the most basic maths tasks. The teacher has informed me that M is often absent from school as she has anaemia. She tires easily as a result. M tries hard, but is not always able to keep up with her peers. Once she has grasped concepts, she remembers, but it is a struggle. M required constant repetition of the skills and concepts taught and used concrete apparatus and her fingers to work out the answers to the most basic addition problems. She was not able to work with numbers bigger than ten as she did not understand the value of the bigger numbers. It was recommended that she spend more time to consolidate her mathematics and literacy skills at the end of that year. I observed her again in general during the second cycle of action research in the same classroom. M. still experienced difficulty in all areas of mathematics, but memorised some of the bonds for addition and subtraction as a result of constant repetition and support from her parents at home.

Z is a learner with severe spatial orientation difficulties. His behaviour and the spatial arrangement of the work in his workbook indicate that he could have gross and fine motor difficulties. Z struggles to copy from a page or the board on to his book. He has to move around and is constantly out of his chair and requesting to go to the toilets. Z will sharpen pencils all day long, if allowed, and seldom completes tasks. Some of this is work avoidance tactics, but is also related to his inability to copy from the board and write in lines in his book. He struggles to organise his work space and the work in his book. I requested that the class teacher discuss this difficulty at the ILST meeting so that Z can be referred to a physiotherapist for assistance. During a discussion with the class teacher I recommended that he be given shorter tasks to complete and if possible it be copied into his workbook either by the teacher or another learner. The solving of the problem and the working out of the answer can then be in his handwriting. In the mathematics class how Z solved the problem and what answer he provided are secondary to writing neatly in lines. I suggested that she however, perseveres with the handwriting during handwriting period. Z also spent more time in the grade 2 class in the following year. His handwriting and work organisation showed some improvement during the second cycle of action research. This had a positive effect on the mathematics too as he developed self-confidence and was much more task orientated.

L is easily distracted from the task at hand, but seems to have the necessary potential to make good academic progress. He rushes through tasks and makes unnecessary mistakes. L wants to finish as quickly as possible so that he can draw pictures in a book or interfere with other learners. When he discovered that he understood the maths and could complete the tasks correctly, this learner blossomed and displayed good maths ability and a love for the subject. He was able to manipulate numbers and needed very little input to transfer knowledge from the concrete level to the abstract. L also had a comprehensive understanding of the value of bigger numbers. His June report at the end of the first cycle of action research showed a marked improvement in the subject of mathematics.

4.4.5 Classroom organisation

I will now discuss my observations and reflections as recorded in my research journals regarding classroom organisation, changes implemented and outcomes reached.

4.4.5.1 Observation and reflection

During the observation sessions it was noted that the maths lessons were often interrupted by messages from the office, requests from other teachers, as well as money matters. The teacher had to struggle after each interruption to refocus the learner's attention. The teacher was called out of her classroom to perform duties as HOD on eight occasions during the sixteen observation sessions of action research cycle one. More than half of the teachers in Canada who took part in a survey regarding the impact of interruptions on mathematics teaching time indicated that these interruptions had a severe impact on the teaching and learning of mathematics as instructional time was wasted and learners struggled to concentrate (Leonard, 2001:107-108).

Every morning the learners all come together on the mat to share their news. The mat consists of carpet squares that have to first be put into place on the floor. The groups then lead to the mat, the weakest learners sitting closest to the teacher near the front. During the first half an hour of the day, the teacher and learners attempt to share their news from home with one another while the classroom is constantly interrupted by learners from other classes bringing money, asking for items, etc. If a teacher from one of the other classes is absent, the grade 2 HOD (the research study class teacher), leaves the classroom to go and organise the learners from that teacher's class. All of these interruptions have a negative impact on teaching time. On a Monday, the maths time is interrupted by assembly period which often begins late and ends late, further interrupting and shortening teaching time. Interruptions continue during the first hour of the day and well into the maths period. The learners are also more disruptive and take longer to settle down to work on a Monday.

For the maths lesson, the teacher divides the class into four groups based on their performance in the maths continuous assessments. The big number of learners in the classroom and the time constraints make it very difficult for the teacher to manage her time effectively. She is only able to teach two of the groups in small group format during a short time period for mathematics per day.

After spending a good half and hour on the mat while various administration matters are seen to and also sharing their news for the day, the learners then remain on the mat for the start of the maths lesson. By now the class has been interrupted a number of times and the learners are starting to get restless. The teacher uses this time to practise number patterns, go over the previous days work and explain the new task on the board to be completed that day. This long period on the mat makes it hard for the learners to sustain concentration and focus upon what is required. After about 80 minutes in total on the mat, the learners are then sent on a toilet break.

When they come back to the classroom, the learners are then expected to complete the task on the board in their books at the tables. By now, the weaker learners having not concentrated fully while the teacher was explaining and having left the classroom for a short period of time, have forgotten what is required of them. Monitors (learners), hand out the books while the teacher makes sure that everyone knows what to do. She normally repeats the instruction. Teaching is further interrupted by a number of learners who have come to school without the necessary stationery. The teacher has placed some stationery for everyone to share in containers on each group's tables, but the learners have lost items and fight over whose pencil belongs to whom.

Once everyone is working the teacher calls out a group of learners for small group teaching on the mat. The teacher only has enough time to call out two of the groups per day. She alternates the groups during the week, giving all groups equal time. The faster working learners have finished their task before she has even completed her first group teaching. The learners are left to occupy themselves once they have completed the required task at the tables. The teacher checks on the learners at the tables before calling up the next group. The learners at the tables who have finished their maths tasks are now bored and noisy. This further disrupts teaching. Some learners finish their tasks quickly and some are not able to even complete one task.

4.4.5.2 Implementing change

We discussed the constant interruptions of teaching during one of the informal discussion sessions. The teacher has become so used to the constant interruptions that she did not even notice it any more. After this conversation the teacher became more aware of the amount of teaching time lost due to interruptions. She then put certain guidelines in place for the teachers under her control and limited the interruptions to the first 15 minutes of the day.

The teacher has tried different approaches to starting the day with her class. She tried to keep the learners at their desks to share their news, but found that they were not quite so eager to share when spread throughout the classroom.

I suggested that a carpet be bought for the classroom to alleviate the impact on teaching time taken by the setting out of the carpet squares. The teacher prefers the carpet squares as each learner has an allocated place to sit. Some of the learners in the class now set up the carpet before school starts in the morning to minimize the impact on teaching time.

A further recommendation to the teacher was that she makes the initial maths teaching and consolidation time shorter, as the learners could not concentrate for such a long period on the mat. She could rather utilise the time when teaching in small individual groups. The teacher tried this and just did some counting or number pattern exercises for a 10 to 15 minute period before taking the learners to the toilets. This is in line with the FfL campaign 2008 – 2011 (South Africa, 2008:5) of how a mathematics lesson should be organised. The learners' concentration improved and the teaching time was better utilised.

The teacher made less use of the board and wrote some exercises for the learners on loose pages of paper. While the monitors were handing out the books the teacher went to each ability group and explained what their task was for the day. The monitors handed out the task pages. The teacher also provided a second task for the faster working learners who were finished before the maths period was over. Some learners were, however, still not completing their tasks.

During action research cycle two, I suggested that the teacher prepare a variety of work cards with number concept exercises in basic operations, counting activities, number patterns, etc. This would allow the faster working learners to do more exercises. The teacher could do quality control by marking the books every day, having competitions about who did the most cards neatly and correctly, etc. The teacher did not feel comfortable with this suggestion as it would be time consuming and would be a financial cost that the school could not afford at that time. We compromised by deciding together on the idea of an activity book. The teacher had an existing activity book that she had used on previous occasions to consolidate work taught in grade 1. The teacher collated the activity book worksheets from various resources that provided practise of calculation and counting concept activities on a grade 1 level. Once the learners had completed their daily required maths task in their workbooks, they would then have the opportunity to do fun mathematics exercises in their activity book to further consolidate their number concept knowledge on a grade 1 level during the first term of 2009.

Mathematics period on a Monday was always shortened and rushed due to the time spend at assembly and then having to regain the learner's attention. After discussion, the teacher added an extra half hour to her maths teaching time on a Monday so that the learners would still get the benefit of a ninety minute lesson as proposed by the FfL campaign 2008 -2011. The minimum expectation advocated, is that learners be actively involved and being taught mathematics during at least 1 hour per day (South Africa, 2008:7).

The teacher has tried a variety of strategies to alleviate the stationery problem, but to no avail.

4.4.5.3 Outcome

Interruptions of mathematics teaching time is now less of a problem with the other teachers responding well to the boundaries set by the grade 2 class teacher. A smaller amount of teaching time is wasted on matters that could perhaps have waited till break time or be settled after school.

Less teaching time is wasted as the teacher and some learners set up the classroom before the start of the day. This is not always possible, but has been mostly successful.

The shorter time period spent on the mat as a whole class in the morning has been very beneficial. The learners concentrate better and there is a reduction in the noise levels in the classroom. They take part in the counting and mental mathematics sessions with enthusiasm and respond well to consolidation of a variety of number concept activities. The teaching time saved, is better utilised in the individual small group teaching sessions.

After the toilet break and while the monitors are handing out books, the teacher explains to each group what their task for the day is. Fewer learners come and ask what they must do and a smaller amount of time is wasted by explaining everything again. Each group repeats their own instruction back to the teacher. Not only does this model mathematical language, it also helps those who struggle with auditory memory to have a second opportunity to know what to do.

The activity book exposed learners to a variety of number concept activities (grade 1 level) that they can practise at their own pace. The learners discuss the activities with one another and help each other in the groups if they don't know what to do. Peer learning can be a very successful tool. The learners are constructively busy with number concept development during the whole maths period and do not have to sit and wait around, wasting time while the teacher is working with a small group.

The extra half-hour of teaching mathematics on a Monday has also been beneficial. The Monday mathematics lesson is less rushed and the teacher is less stressed as she has sufficient time to teach what is required for that day. The teacher has the time to settle the class before starting with the mathematics lesson, making teaching more effective.

The shortage of stationery is an ongoing problem. The teacher found that it was the same learners who came to school without pencils every day. Initially she provided pencils to them, but would have to do so again at the start of the new day. The teacher continues to regularly replenish the stationery holder on the tables, but the shortage of stationery and daily battle to resolve it remains a never-ending problem.

4.4.6 Teacher's planning[9]

While planning, teachers should consider what they want to teach in a specific lesson and how it fits into the scheme of work. The teaching of number concept is guided by the learners and not by prescribed curricula (Ollerton, 2004:13). I will now discuss my observations and reflections regarding the teacher's planning during the action research period, as well as changes implemented and outcomes reached.

4.4.6.1 Observation and reflection

2009 was the first time that the teachers used the FfL campaign guidelines 2008 – 2011 to direct their planning. The guidelines are very clear and easy to follow and have a variety of different areas of mathematics to cover over a set two week period (South Africa, 2008). According to policy prescribed by the National Department of Education (South Africa. NDE, 2002), the teacher must spend 65% of the teaching time on learning outcome 1 which is the development of number concept.

The teacher's task was made more difficult by the fact that during 2009 she had 43 learners in her class of which 20 were intervention learners. Planning was curriculum-orientated and did not take the needs of her learners into consideration. The teacher was trying hard to keep up with the weekly guidelines as required by the school. The majority of the learners were not on the required level and the teacher had a hard time trying to catch up as well as get the learners to master the new concepts.

During the first action research cycle, the teacher's planning sheets consisted of handwritten notes that covered a two week period. The planning was dated 20 July to 31 August, 3 August to 14 August and a page that was not dated for the following two week cycle. My observation period started on 22 July and ended on 16 September. The planning has no clear structure and encompasses a variety of new concepts in different areas of mathematics to be taught over a two week period. Often new concepts are taught without the laying of the foundations required.

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9 See examples of teacher's planning at appendix H and appendix I

Progression was not always clear. There was no indication of differentiation for learners who need intervention. The teacher allowed for consolidation, utilising repetition of concepts. For examples of the teacher's planning during action cycle one, please see appendix H.

4.4.6.2 Implementation of change

I assisted the teacher with her planning by suggesting that she should differentiate for her slower learners by introducing the same concepts in a lower number range. This would allow for the slower learners to develop at their pace. The average and above average learners in the class could still move forward as indicated and required by the curriculum.

During cycle two of the action research, I provided the teacher with a lesson plan example for implementation during a two week period. The lesson plan showed the teacher how she could differentiate for the ability groups while still following the guidelines set out by the FfL campaign 2008-2011 (South Africa, 2008). The provided example plan was an attempt to provide guidance re the optimal utilisation of teaching time, classroom organisation during a maths lesson, as well as resources. The teacher is still required by the FfL lesson plans (South Africa, 2008) to teach a variety of different concepts during a two week period, but there is progression and development of the concepts as the term proceeds.

4.4.6.3 Outcome

The teacher is adapting her lesson plans to provide for differentiated teaching. Her lesson plans reflect that the learners are working on the same concepts at different levels. There is evidence of cohesion and progression in the teaching of number concept activities. (See attached examples of planning during cycle two: Appendix I.)

4.4.7 Assessment

As discussed at length in **Chapter Two**, assessment should form an integrated part of the teaching and learning of mathematics in the foundation phase. The National Curriculum Statement (2002) and Assessment Policy (2007) for Grades R-3 (Foundation Phase) document inform teachers about the purposes of assessment and different assessment strategies. The guidelines for mathematics indicate that the learners have to complete three assessment tasks per term and thus twelve tasks per year. (South Africa. WCED, 2009:218). I will now discuss my observations and reflections regarding assessment that took place during the action research cycles, as well as changes implemented and outcomes reached.

4.4.7.1 Observation and reflection

During the observation sessions in the classroom, I noted that the assessment tasks were implemented in an indiscriminate fashion. The assessment tasks, as well as when they were to be implemented, were planned, but I had the impression that the teacher had not yet had the opportunity to teach the work that was about to be assessed as required by her work schedule. This required the teacher to quickly teach what had to be tested before the assessment was due to be completed. In turn, this resulted in teaching similar items to what was due to be assessed as well as the teaching of concepts, rather as rote methods to be memorised, than teaching for understanding. Progression in the hierarchy of the teaching of concepts was also not considered.

4.4.7.2 Implementation of change

During informal discussions with the teacher, she became aware of the importance of learner-orientated teaching and assessment as well as the progression in the teaching of concepts. During the interview the teacher mentioned that: *"Emm, (silence), yes I think, I think it is important that we eh, take note of the progress of the numbers development with learner and aaa also to always continue consolidate and then move on to the emm, next progression of that of that concept" (Transcript of interview).*

4.4.7.3 Outcome

During the second cycle of action research in 2010 it was noted that there was not only a marked improvement in the planning and preparation of lessons, but also in the planning of assessment tasks. An assessment roster was drawn up for the terms, consisting of the dates when assessments would take place and what form it would take. This corresponds with the work schedule and teacher's planning of the term.

4.4.8 Utilisation of LTSM[10]

Here I discuss my observations and reflections made about the utilisation of LTSM during the teaching of number concept in the action research period, as well as the implementation of change and the outcomes reached. Learners should be allowed to use any apparatus in the mathematics classroom that is meaningful to them to help them to understand what they are learning (Borgioli, 2008:187).

4.4.8.1 Observation and reflection

The teacher has access to a number of wall charts, supplied by the school, as well as apparatus to teach practical maths such as shape, provided by the WCED. There is a shortage of manipulatives (not enough for each individual learner) to utilise in the process of the teaching and learning of number concept. As a result, the teacher uses manipulatives to demonstrate to the learners and the learners do not actually get to handle the concrete apparatus to form their own understanding of concepts. She also does not allow the weaker learners to use the concrete equipment at their desks to enable them to work out their basic operations correctly.

When she does hand out the concrete apparatus to the group on the mat, two learners must share. One uses the apparatus to work out the answer and the other partner has to write the solution down on the little blackboard. They then swop roles. *Learner K now refuses to take part and the teacher later on tells me that he wants to work with the blocks and does not want to do the writing* (Excerpt from Journal 1: 22 July 2009). This is a clear indicator that this learner is not yet developmentally ready to move from the concrete to the abstract. This learner should be given ample opportunity to engage with the concrete and then guided by utilisation of semi-concrete to abstract thought processes. Piaget's stages of development (1955:2) indicate that some learners still need concrete apparatus while others are able to work with semi-concrete representations or solve problems with abstract thought.

The teacher makes extensive use of the 100 number chart and each learner has their own copy in a flip file. They use this apparatus to count on and back by rote in various multiples as well as the solving of addition and subtraction sums. She also uses this apparatus to teach the identification and position of numbers. The teacher also lets the learners count on in multiples of four, using their fingers. They say every fourth number out loud.

[10] Learner and Teacher Support Material

When working with money and breaking up 50c into equivalent coins, she uses the learners' money that they brought for tuck shop. Once again the teacher demonstrates and the learners watch and listen. The teacher indicated to me that she could not find her play money.

During a lesson on place value, the teacher uses flard cards to demonstrate. Once again, the learners do not have the opportunity to handle the apparatus to form their own understanding. *The teacher builds the number 11 with the flard cards. The 1 stands for a 10, and the 1 stands for a unit. She calls a learner to hold 10 unifix and another to hold 1 unifix. One stands for one group of ten, or one ten. She gives another learner ten more unifix. How many blocks do we have now? The learners chorus: 21. How do we write 21? Chorus: a 2 and a 1. What does the 2 stand for? The teacher continues with this and also does 31 and 41. The teacher does the same with 12 to 42. She links the flard cards to the concrete, but only a few learners actually hold them – materials are used to demonstrate rather than for learners to work with* (Excerpt from journal 1: 17 August 2009).

Other apparatus used includes a clock while teaching time, computer with the Cami Maths Programme, where learners did individual work in the computer room, and worksheets.

4.4.8.2 Implementation of change

I assisted the teacher in the acquisition of concrete apparatus by collecting bottle tops, getting a donation of ice-cream sticks from an ice-cream factory and also gave her the unifix blocks and play money from the MST kit in my classroom that I was not utilising at the time. Upon further investigation, I discovered that most of the teachers in the Foundation Phase at the site of research also experienced a shortage of concrete apparatus. I endeavoured to provide them with apparatus as well. I encouraged the teacher not to just use the apparatus for demonstration purposes, but to allow the learners to handle the manipulatives on the mat. The weaker learners were also allowed to use manipulatives to find solutions to their problems when they needed to.

The teacher used the 100 chart in a more constructive way. The learners were encouraged to count in multiples and to mark the multiples with counters on the chart. This also gave them a visual representation of the number pattern.

I assisted the teacher in the utilisation of flard cards. The weaker learners found this very helpful and were able to break up and build up numbers. They referred to 42 as a 40 and a 2 rather than a 4 and 2. I asked the teacher to rather adopt 40 and 2 as 42.

4.4.8.3 Outcome

The learners benefitted from being able to use concrete apparatus to solve problems and form their own understanding and were able to move on to semi-concrete and abstract thought. The teacher lost her fear of allowing the learners to used concrete apparatus and formed a renewed understanding of the hierarchy of teaching learners utilising concrete apparatus, semi-concrete representations and then abstract reasoning.

4.4.9 Teaching strategies

In this section I discuss my observations and reflections made during the action research cycles as recorded in the two journals as well as the changes implemented and the outcomes reached.

4.4.9.1 Observation and reflection

The teacher utilises a variety of teaching strategies during her mathematics lessons. During the first observational cycles of the action research case study, I noted that the teacher used a **differentiated group teaching approach**. Learners were clustered together in three ability groups for mathematics.

Even though the teacher divided the learners in her class into different ability groups and taught each of these groups separately, there was no differentiation in number range, concepts taught or consolidation activities.

During action research cycle one, the teacher mostly utilised the **talk and chalk method**. The teacher preferred to have the whole class on the mat. She taught the new concept for the day and then consolidated by discussing the previous day's maths exercise that was on the board with the learners. The teacher allowed individual learners to provide the answers and fill them in on the board. After the toilet break, the teacher asked the learners to mark their previous day's work from the completed exercise on the board. They copied down the correct answers. The teacher would then write that day's exercise on the board.

The chalk board exercises initially often only required copying. The learners were asked to write the correct number names. The teacher wrote the number names from one to ten on the board so that the learners could just copy. No thinking required, answers provided. This is an example of a possible exercise:

50 fifty

51__________

52__________, etc.

The learners often practised concepts by means of **'chorus' work**. The teacher asked for the answer and the class would answer in 'chorus'. While there is a place for 'chorus' or drill work in mathematics in the memorising of bonds and tables, I wondered at times if the learners fully understood what they were doing of if they just copied and repeated. 'Chorus' work can become meaningless as no real thinking is involved and the learners tend to lose concentration.

Group work on the mat where the teacher worked with small groups allowed for more individual time spent with the learners to teach and consolidate new concepts. There was not enough concrete material for each individual learner in the group[11]. Learners were encouraged to share resources. Collaborative learning, as advocated by Vygotsky, can be very beneficial to the cognitive development of a learner (Blunden, 2001:5).

While teaching halving, the teacher taught the learners a **specific method** on how to work out the answers. The researcher observed that the teacher taught the learners a method to halve two digit numbers. Some of the learners were able to memorise and apply this method. Other did not know that they were halving and why they were breaking up the number into tens and units. The term assessment showed that the focus group learners did not understand the actual method or how and why it works.

4.4.9.2 Implementation of change

The teacher uses a variety of teaching strategies. Her methods of choice reflect the way that she has been trained as a teacher for the senior phase. Foundation Phase teaching necessitates hands-on, concrete, allowing learners to experiment, not demonstrate and lecture

[11] See utilisation of LTSM

as in the senior phase. The teacher is open to try new ideas and became comfortable in adjusting her teaching techniques to allow learners to use concrete apparatus at the tables and on the mat, when needed.

4.4.9.3 Outcome

During the initial action research cycle observation sessions the teacher did not utilise the problem solving approach to teaching. She now understands the importance of allowing learners to experiment and discover by themselves with guidance from her. This has been a significant mind shift as she was very dependent on the rote way of teaching.

4.5 Conclusion

In this chapter I discussed the context of the research pertaining to the school environment, the teacher and the learners. The different action research cycles that took place, the intervention implemented and the conclusions reached were discussed in detail.

In **Chapter 5**, I will endeavour to answer the research questions in detail utilising information contained in the two research journals to critically analyse the teaching and learning of number concept in a grade 2 class in the Western Cape.

CHAPTER FIVE

ANSWERING THE RESEARCH QUESTION

5.1 Introduction

In **Chapter Five**, I will endeavour to answer the research questions stated in **Chapter One** utilising data collected during the action research in praxis case study. An attempt will be made to critically analyse the teaching and learning of number concept in a grade 2 classroom in the Western Cape. This attempt will be guided by my experiences, reflections and findings as contained in the research journals which include the observations made during mathematics lessons in the grade 2 classroom.

5.2 How do learners in a grade 2 classroom in Manenberg acquire number concept skills?

During my research visitation sessions in the grade 2 classroom, I observed how the learners in the focus group acquired number concept. At times, whole class teaching occurred and I noted my findings regarding the whole class. I will now discuss my findings in the superordinate and subordinate areas of number concept development that formed the focus of my research.

5.2.1 Counting

During action research cycle one, the teacher utilised mainly rote counting methods linked to the 100 chart. There was no progression in action research cycle two. She still continued to use rote teaching methods. The only changes were that during action research cycle two, individual learners were now allowed to handle concrete apparatus and she taught the concept of estimation.

5.2.1.1 Action research cycle one

Counting was mostly taught during whole class sessions. The learners in the grade 2 class practised their verbal counting skills in 4 out of the 16 sessions that I attended during the action research cycle in 2009.

*Group 1 and 2 are able to count quite well in their groups, but group 3 (focus group) and 4 have lost interest and do not present as learners who know how to count in multiples...The weaker learners start to act out and the teacher has to reprimand Learner L (*Excerpt from Journal 1: 22 July 2009).

The weaker learners in a class often get lost in a big group activity. The teacher should ensure that the weaker learners have mastered counting in multiples before repeating the activity as a whole class consolidation.

The learners (whole class) completed a written counting activity during 3 of the sessions. The one counting activity required of the learners to complete multiples of 10 and the other activities consisted of the writing of numerals and number names. These activities were merely copy or transcription type of exercises. The teacher writes the number names from 1 to 10 on the board. She then gives an exercise for learners to write the number names from 50 to 59. She writes the word fifty on the board. The focus group learners finished this activity in very little time. The boys in the group interacted with one another and checked what the others were doing while M just ignored them and continued with her task.

Teaching Group 3 (focus group)

She then sends all the learners to their tables to start the written activity. She calls group 3 (focus group) to the mat with their flip files. The flip file has a 100-chart and number-line to 30. She instructs them to count in fives from number one. They use their 100-chart and count on 5 numbers from number 1, using their fingers to point at the numbers. The learners say 6, then count 1, 2, 3, 4, 5, to the next number, pointing with their fingers and say 11. They then repeated the exercise counting only on their fingers. They count four numbers softly and say the fifth number out loud. The teacher asks individual learners to predict which number would be the next multiple and all of the learners could answer correctly. She asks them to practise counting backwards in fives and from number 2 on in fives at home (Excerpt from Journal 1: 22 July 2009).

In my reflection about the above lesson I observed that the learners did not understand that counting on makes more and counting back means less. The learners used a 100-chart successfully coupled with their fingers, but had no clear concept why they were practising to count in multiples of 5. The teacher did not have enough counters for individual learners to use and compromised by allowing learners to use their fingers. Counting from 1 to 5 instead of counting on 5 also does not build the concept of counting on or the concept of counting in multiples. I have the impression that the parents teach the learners the number rhyme of how to count in multiples at home and that the teacher then just consolidates in class.

The teacher continues with the lesson in multiples with the focus group. The learners work together in pairs using 20 unifix blocks (two sticks of 10 in two different colours) and one small blackboard.

The learners are then asked to organise their 20 blocks into groups of 2, 4, 5 and 10. Each pair of learners gets a different multiple to work with. One learner does the grouping with the concrete apparatus and the other one must write what is happening on the little blackboard. Learner K now refuses to take part and the teacher later on tells me that he wants to work with the blocks and does not want to do the writing.

Learner M and Learner Z:

Learner M is very quiet and withdrawn. Learner Z groups the unifix blocks into groups of 4. Learner M writes 4+4+4+4+4=20.

The teacher tells the learners to match the concrete blocks to what they have written to check if they have written correctly. They do.

Learner A and Learner L:

L groups the blocks into groups of 5. A writes: 5+5+5+5=20

Learner K and Learner R

The teacher tells K that he has to take part and do the writing and not the grouping. R arranges the blocks into groups of 4. K writes 4+4+4. R checks K and matches the blocks to the writing. K then corrects and writes: 4+4+4+4+4=20 (Excerpt from Journal 1: 22 July 2009).

This section of the lesson teaching the building up and breaking up of number 20 incorporated and expanded the basic concept of multiples and was very successful. All the learners took part. They worked together collaboratively, assisting one another and checking one another's work. This allowed K to move away from his comfort zone in working only with concrete apparatus progressing to writing the number sentence down while matching to the concrete. Vygotsky theorised that cognitive development takes place when learners achieve while interacting collaboratively with the teacher and other learners (Blunden, 2001:5).

The teacher further developed this lesson to include the concept of multiplication. This is a good example of how the basic concept of counting in multiples can be used to build out other concepts such as the building up and breaking up of numbers as well as the concepts of repeated addition and multiplication.

During a follow up counting lesson with the whole class the teacher used a 100-chart to count in multiples of 4:

The teacher placed counters on the 100-chart to indicate the intervals... One learner is pointing to the number chart with a stick while the others are counting in fours. They are revising. The teacher instructs them to say the numbers softly and the fourth number out loud. The learners count, but get confused: 4, 8, 11 – some say 11 and not 12 – others say 12. The pointer loses where he is supposed to be. They start again from the beginning. During this whole group counting exercise, Learner K is playing with his new pencil and eraser... L is fiddling, M is trying to count – the other members of group 3 have given up... The teacher calls upon L to focus and count – they do this quite well reading off the marked number chart. (Excerpt from Journal 1: 27 July 2009).

The focus group learners are following the visual representation of the multiples of 4 as marked with counters on the number chart, but they are still counting by rote, merely repeating the number rhyme without any real understanding. This becomes apparent when they are unsure of the next multiple (11/12) while following the marked numbers on the 100-chart. All the learners of the focus group (group 3), with the exception of M, are not benefitting from this exercise and are distracted. They are, however, able to count while the answers are provided to them by following the marked 100-chart. The marked 100-chart can be a useful teaching aid if learners work out and cover the correct multiples individually, because it provides a visual representation of an abstract number pattern and can assist learners to form relationships between numbers. In this activity the 100-chart is used to drill and consolidate counting in 4's without any real understanding.

During a follow up lesson, the focus group learners got the opportunity to extend and consolidate their counting in multiples while using counters in conjunction with the 100-chart on an individual basis.

The teacher gives each learner some buttons to pack on their 100-chart to indicate counting in four's... Most of group 3 pack their buttons by looking at the example 100-chart with counters stuck on it – copying and not actually exploring or counting for themselves. K puts his buttons on R's chart – does not want to take part. The teacher speaks to him and gives him more *buttons. L puts his buttons out – counting. M tries too. Z and R copy from the board. K tries to do this by himself. A gets quite involved with the activity and seems to be concentrating hard. K helps R to do his and in the process rearranges the number grid paper which in turn moves all the buttons to the wrong positions. He tries to rectify this. Z takes all his buttons off – he is a procrastinator. The teacher encourages him to do it again. The teacher instructs them to count the number they put the button on out loud. Count in 4's* (Excerpt from Journal 1: 27 July 2009).

The teacher extends the above activity by letting the learners also count on their fingers saying every fourth number out loud. She then packs out unifix blocks in groups of 4 and demonstrates while they all count in 4's. Her last instruction is that learners should go and practise counting in 4's at home.

This counting activity was moderately successful. The learners interacted with the practical equipment linked to a visual representation of the 100-chart. Most of the learners in the group experienced success and took part in this lesson despite the constant interruptions and rising noise level in the class. Two of the learners just copied what was represented by the example on the board. This is an indicator that they do not have a clear understanding of counting in multiples as yet. The other learners in the focus group seemed to have grasped the concept.

In the morning when the teacher writes the date on the board, she asks the learners which number comes before or after the date. Individual learners get the opportunity to use the 100 chart to identify specific numbers during the morning mat session and to say which number comes before, after or is two less or two more. The learners in the focus group practise sequencing as follows:

She asks the group which number comes before 20; which number is two numbers before 20; which number comes after 21; how do you write 21?. The learners promptly responded a 2 and a 1. She then asks which number is two numbers after 20. The learners seem stumped. She then asks if the number is going to get bigger or smaller. She repeats is 22 bigger or smaller than 20? The learners seem confused and she informs me that the bigger and smaller concept needs practice, but that she would not be addressing that today. Learner K is now fidgeting and has lost interest. (Excerpt from Journal 1: 22 July 2009).

The focus group learners experienced grave difficulty with sequencing as they had no idea of the how many of a number. The learners thereafter in another lesson learnt by rote that counting on means the numbers gets bigger and counting back means the number gets smaller. They did not pack the numbers out in concrete equipment to compare the size of the numbers. The learners also referred to the number 21 as consisting of a 2 and a 1. This indicates that they have no idea of place value.

5.2.1.2 Action research cycle two

During the action research cycle of January 2010, the learners did verbal counting exercises during 6 of the sessions. During 4 of the10 sessions in total, very little or no mathematics was taught due to disruptions in the school day.

Verbal counting activities mostly consisted of rote counting with the whole class for a period of 20 to 30 minutes while all the learners were sitting on the mat. The teacher used a 100-chart to guide the counting. Some individual learners (some focus group learners) would get the opportunity to point to the numbers on the 100-chart while the learners were practising their counting. The learners (whole class) practised the following types of verbal counting activities:

- counting on and back from a specific number,
- counting on and back in multiples of 2's, 4's, 10's, etc.

Rote counting as defined by Anghileri (2002:21), practises the memorising or repetition of the "number rhyme". In this instance it is used as a teaching method to memorise the multiples of specific whole numbers. Rote counting used in conjunction with a number chart gives the learners the opportunity to visualise and form and abstract number line in their minds on which to place the multiples practised, while memorising the "number rhyme". This also facilitates the process of counting on. Competency in counting includes being able to count backwards and forwards from a specific number as well as counting in multiples (Beswick et al., n.d.:2). The teacher must ensure that the learners have a true understanding of the concept of number patterns and an understanding of the numbers that they are counting (Baratta-Lorton et al., 2010:51).

I did not observe learners practising one-to one correspondence counting as a specific skill during my class visitations during action research cycle 1. Some of the learners get the opportunity to count out 30 blocks during one of the lessons in action research cycle 2. Learners need a lot of concrete experience to develop their concept of number. While counting physical objects, learners learn the difference in quantity between two numbers through comparison. They also develop an understanding of the size of numbers, e.g. it takes longer to count 50 blocks than 5 and 50 blocks take up more space than 5 blocks (South Africa, 2009:5-6).

The teacher calls group 2 to the mat and does some counting exercises with them. Individual learners get an opportunity to count out 30 counters. The teacher gives them a variety of objects, including an abacus, to count with. Not all the learners in the group have their own concrete material. The teacher feels that only every second learner should have as the others then don't concentrate and play with the equipment. I ask the learners what is the fastest way to count out 30 objects. They respond – in tens. When I ask the learners why we need to be able to count, I am met with blank looks. It seems that counting to them is just counting by rote or practising counting. We then talked about various things that we count and why (Excerpt from Journal 2: 25 January 2010).

This group of learners consist of the average learners in the class. The teacher used a variety of apparatus to encourage learners to count different objects. It was obvious that the learners had prior experience of counting and they achieved success with the counting out of 30 blocks. They also knew the quickest way to count out the 30 objects. The learners have counting skills, but were not provided with a context of why they had to count out 30 blocks. This limited the scope of the intended activity to rote practise. Not all the learners were able to practise with the concrete apparatus as they had to share.

While peer teaching is a worthwhile and very effective teaching method, all learners should be encouraged to get the opportunity to count their own objects. The positive aspect of the learners sharing was that one learner checked the other learner's counting effort. Another way to approach checking the correctness of the amount of objects counted could have been to allow learners, after counting, to swop places and check a friend's counting activity.

Learners could also have been asked how many objects are in a specific container allocated to them. The totals could then have been displayed on a graph. This would allow for a context or reason to count the objects and the number range could be extended allowing for different learners to count out objects of different amounts. This type of activity lends itself to meaningful counting, comparison of the size of numbers, the development of counting on skills and mathematical reasoning.

The "ability to approximate or estimate" is considered one of many components of number sense (Berch, 2005:333). The only opportunity that I observed learners practising their estimation skills was during action research cycle 2 in 2010.

She calls the weaker learners in her class to the mat and does estimation with them. The teacher puts out a group of counters and the learners must estimate how many there are. She covers it with a cloth and then asks them to guess. They make the counters into groups of ten *and then count them to see who was the closest to the correct answer* (Excerpt from Journal 2: 2 March 2010).

The above exercise relied more on the visual memory perception of the learners than the skill of estimation. Learners should be given multiple opportunities to practise estimation using the same type of unit, e.g. string, in a variety of different contexts (Van de Walle et al., 2010:140-141). Estimation should form part of the process of the acquisition and understanding of basic arithmetic operations and will reveal if learners have the correct understanding of the process of addition (the number increases in value) and subtraction (the number decreases in value). Learners who are able use the skill of estimation with success are also able to achieve success in basic arithmetic operations (Jordan et al., 2006:155). It is of concern that this was the first and only time that I observed the teacher allowing learners to practise estimation as this skill is of paramount importance in the development of number concept.

5.2.1.3 Critical reflection

The whole class practises rote counting almost every day and have memorised the counting order as well as counting forward and backward. Most of the class have acquired a good understanding of counting as they are able to count in multiples from any number forward and backward. This to me is the true test of whether learners can truly count. Whilst being able to count, I question whether the learners have a true understanding of the how many of a number as they very seldom use concrete equipment to represent numbers bigger than ten. When they do use concrete equipment to represent numbers, they have to share and only one of the two learners actually is able to use the counters. I am also concerned that so little time is spent on constructive counting exercised during the mathematics lessons.

One of the learners in the focus group still struggled to count out five counters one-to-one correspondence. The other focus group learners were able to count out ten counters and understood counting in multiples of two and three utilising their number chart. All of the focus group learners except one experienced difficulty with the sequencing of numbers from big to small and small to big as they had no understanding of the value of the bigger numbers used in this exercise. Most of the focus group learners had a fair understanding of the value of numbers to 20. Learner L had a good understanding of the value of bigger numbers to 100. It is of interest that Learner L also experienced more success in the solving of arithmetic problems. It stands to reason that Learner L has better underlying number concept than the other learners in the group. Regular effective counting practise and a good understanding of place value allows for a better understanding of the value of bigger numbers (Frobisher et al., 2002:27; Hopkins et al., 2001:9).

5.2.2 Calculations

During action research cycle one, the learners solved arithmetic problems mostly using rote methods, counting on their fingers, counting on the 100 chart and following set methods. During action research cycle two, the teacher introduced a problem solving approach, allowing learners to discover their own methods and share it with others.

5.2.2.1 Action research cycle one

The learners practise calculations during 12 of the 16 sessions that I attended in action research cycle 1 in 2009. This trend continues and they do calculation activities during 8 out of 10 observation session during cycle 2 in 2010. There was no mathematics teaching in the other two sessions due to interruptions in the school day which was outside of the teacher's control. The calculations practised mostly consisted of the completion of numbers sentences. Even though most of the mathematics lessons were used to practise calculations, the written tasks were limited and consisted of what the teacher could fit on the blackboard. During one mathematics lesson, learners would typically complete eight to ten sums, sometimes less.

During action research cycle one the teacher used a lesson teaching the building up and breaking of number 20 into different multiples to teach the focus group the concept of multiplication.

After the learners had broken up the number 20 in various multiples and written the number sentences down working together in pairs, the lesson continued as follows:

The teacher writes the following on the board: 2 groups of 10=

She asks the focus group learners how they can work out the answer. They tell her in chorus that she must double the ten. She writes 10+10. She asks them how else she can write it and they chorus multiply. One learner in each pair writes the sum and the answer. Learner M writes 2x10; 2 groups of 10=12. She then counts her blocks and corrects herself. The teacher writes 10x2=20 and 2x10=20. The teacher then talks to the learners about 4x5 being the same as 5x4.

What can you tell me when you turn the numbers around? The learners chorus: the answer stays the same (Excerpt from Journal 1: 22 July 2009).

While this was a natural extension on the lesson about number twenty and included the breaking up and building up of number twenty in different multiples, I would have like to have seen the learners discover the principle of the communitative aspect of multiplication for themselves. The learners seem to understand the concept of multiplication, but when M had to apply it to the completion of the number sentence she needed assistance from her concrete materials. While the teacher uses the concrete materials with success she does not allow for enough opportunity for the learners to discover and experiment.

In the above lesson, the teacher started off the activity by counting in multiples and then taking the number 20 and breaking it up into multiples of 2, 5, etc. This then facilitated the lesson on multiplication. In the following lesson, the teacher used money to allow learners to break up and build up numbers as well as do calculations in a problem solving context. This lesson adds on to the skills taught in the previous lesson as now the learners are not just breaking up the number into multiples (the same number), but into different numbers while expanding the concept of equivalency.

On Friday the teacher used the learner's tuck shop money to do money sums. The teacher points to the sum on the board. You have 5c – Break it up into smaller coins. The learners chorus 2c+2c+1c... The teacher asks: If I have a 5c coin and I ask you that you must give me change, but not a 2c coin, what will you give me? The teacher answers her own question. You are only going to give me 1c pieces. Give me 2 coins to make up a 10c. The learners seem increasingly distracted. A is picking his nose. 5c+5c... The teacher increases the difficulty of the sums progressively ending with the equivalent to 50c.

5c=_+_+_+_+_

10c=5c+_+_+_

20c=_+_

50c=20c+10c+10c+_

(Excerpt from Journal 1: 27 July 2009).

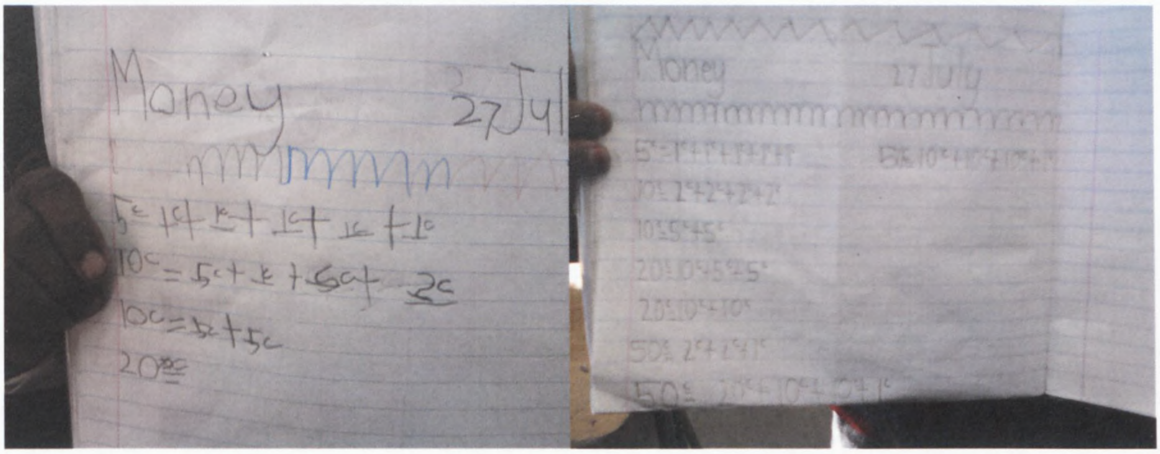
During the revision of the above board activity that the learners completed in their books on Friday, several learners got the opportunity to give the answers. The teacher filled in the answers on the board and informed me that she could not find her play money for the learners to use on Friday. She wrote a similar activity on the board for the learners to complete. Once again the lesson was taught by rote, with the teacher demonstrating using some of the learners' tuck shop money. The lesson is not contextually correct as we do not any longer use 1c coins in South Africa.

She writes the sums and explains them as she is writing. While she is busy A + K are fighting and L is laughing at them (Excerpt from Journal 1: 27 July 2009).

These three focus group learners have shown no interest in the lesson and are not involved yet again. They have again been taught in a whole group situation with no practical apparatus or problem solving interactive opportunities to hold their attention and give them the opportunity to practise the concept of the building up and breaking down of numbers and equivalency.

Group 3 (focus group) is sent to their tables to do the same money sums. The teacher reminds them that there are no 3c coins. She informs me that she cannot find her play money. The learners have to do the sums without any concrete apparatus... L plays the clown/Michael Jackson and dances the whole time – he is able to do the work and completes the task first. Learner A and Learner M count on their fingers and try very hard to complete the task. A is lost. He puts on his spectacles when instructed. Z does the minimum and sharpens pencils, dances with L and generally procrastinates. R tries and succeeds to some extent. K goes missing when instructed to look for his spectacles and does not want to wear them. He ends up sitting in a corner behind the desk and does absolutely no work the entire time (Excerpt from Journal 1: 27 July 2009).

L and R are the only two learners in the focus group that were able to complete the activity with moderate success. The other learners mostly tried to avoid doing the activity altogether. M and A tried hard, but did not succeed. It is clear that most of the learners in the group had not mastered the concepts and skills required to complete the activity successfully and showed limited number concept development. While the learners had every day experience of handling money to buy items at the school tuck shop, they could not link this to the mathematics exercise required of them as it was not taught in context.



I gave the teacher some play money to use with her learners. During the following week the learners progressively built on their concept of money and equivalency.

The teacher revises the money sums written on the board. She used the play money to explain shopping during the previous week. Again I get the impression that she only uses the concrete to demonstrate and that the learners don't really get the opportunity to learn through play or through interaction with hands on apparatus, games…

R1,70=R_+50c+_ etc.

L is bored, yawns and plays with an eraser. When the teacher gets to the last sum, she says that she is quickly going to check with group 3 (focus group) if they understood. The teacher asks K: "How many R1 in R1, 20?" He answers: "R1." She then asks L: "Is that correct?" L answers: "R1." (Excerpt from Journal 1: 3 August 2009).

L and K are the two more mathematically proficient learners in the focus group. They have a better understanding than the other learners in the group and were able to answer correctly even though L was not paying attention. This indicates that they understood what was required of them and were now able to use money to demonstrate equivalency.

The learners are sent to their tables and are given the same story sum as the day before. This time, they have to fill in their own numbers.

My mom gives me a R10. I buy R_________ burger, 50c sweets and R__________ cooldrink. How much did I spend?

The learners (focus group) do their corrections of the money sums – copying from the board and then they do the story sum using their own numbers… I bring play coins to the table and allow learners to use it to work out their corrections. L is not feeling well and is lying on his arms on the table. K builds R2,20 out of a R2 and a 20c piece and corrects his sum. M goes directly on with her story sum as she was absent the day before and missed out on the money sums. I have to remind A that he must copy down the story sum. He has just concentrated on finding and answer. Z sharpens his pencil for most of the activity time… I help him to sharpen his pencil so that he can start. K finds his spectacles and Z is still sharpening – this time a colour pencil. Z starts 15 minutes after everyone else. R is absent. I assist K with play money to do his story sum. K indicates that he will buy a burger for R10 as well as 50c sweets. I ask him if he will have enough money. If you use your R10 only for your burger – will you then have enough money to buy your sweets and your cooldrink? He says no. How much do you think your burger should cost? He says R5. I give him play money. He takes R5 for the burger and 50c for the sweets. How much do you need for your cooldrink? He takes R2. We count it up together. I guide him to first count the rand and then the cents. I ask him if R7,50 is more than R10 or less than R10. He says more. I ask him if he has a R10 and has to pay R7,50 if he will have enough money. He answers yes. I assist him in writing down the number sentence. I ask the focus group learners what will be the most expensive, the burger or the cooldrink? Chorus: the burger. I give K R10 and ask him to pay me R7,50. I am the shopkeeper. I ask him if I can keep all his money or should I give him change. He asks for change. We count on to R10 from R7,50 using the play money. He works out that he must get R2,50 change (Excerpt from Journal 1: 3 August 2009).

While assisting K and other learners in the focus group I discovered that the learners did not have a concept of the quantity of R10. Learner A paid me all his money and did not require his change. He did not think that he should get change. While the story sum did not ask for the learners to work out how much change they should get, I encouraged the learners to work this out so that I could see if they had a true concept of the quantity of R10. Learner K, A and M completed their story sums successfully with the use of the play money, while Z managed to avoid the task altogether. When R came back to school the following day, K explained the money sums to him using the play money. This is significant as it demonstrates that he has grasped the concept and is able to apply while explaining his thought processes. L, M and A were all able to complete their sums correctly, while Z continued with his pattern of work avoidance, sharpening pencils and interfering with the other learners.

The teacher taught the concept of +10, +20 and + 30 from 14 August 2009. I observed her teaching this concept while using a 100-chart and encouraging the learners to count in multiples of 10. When the teacher gave individual opportunities to the learners to provide the answers to the sums on the board from the previous day (also practised at home for homework), L is able to answer the following sums utilising the 100-chart: 45+30=75; 45-30=15.

Every day, the teacher writes a new exercise on the board. The learners complete this exercise in their workbooks and also copy it into their homework books to complete again at home. This exercise is then discussed again the next morning and individual learners are given the opportunity to provide the answers. While repetition of bonds and basic combinations are encouraged, learners should be encouraged to have an understanding of what they are doing and not just memorise the sums or use a visual aid. Learners should be able to count on and back on a mental number-line or be able to add two digit numbers by applying what they have learnt in place value and other skills such as rounding off, building up and breaking down numbers as well as halving and doubling.

The focus group learners are called on to the mat with their number charts. Each learner is given 10 unifix cubes. The teacher instructs them to make them into a group of 10. Put yours and your partner's together. How many do you have now? The teacher shows them the 20 flard card. How many groups of 10 in 20? The teacher points out that the 2 in 20 represents 2 groups of 10. The teacher gives each pair one more block. How many do you have now? Chorus: 21. How do your write it? Chorus: a 2 and a 1. What does the 2 stand for? Chorus: 20. The teacher gives each pair another group of 10. What do you have now? She repeats the previous scenario. How many groups of 10 and how many units? We can break 31 up into 10+10+10+1 (chorus with the teacher). Let's break up 21. 10+10+1 (chorus). Show me 11 blocks. Let's break up 11. 10+1 (chorus). R is not interested at all. The teacher repeats the activity with 13 blocks (Excerpt from Journal 1: 17 August 2009).

During this lesson the teacher is giving the focus group learners the experience of the breaking up of bigger numbers into tens and units using concrete apparatus. This affords the learners the opportunity of gaining a better understanding of the how many or quantity of a specific number and assists them with the concept of the addition and subtraction of the ten. The learners have been busy with this concept for three days and this is the first occasion that they have to gain experience on a concrete level. Previously they have followed the method of counting on and back in multiples of ten on the 100-chart while attempting to add and subtract multiples of 10. These two strategies have also been taught in isolation. Learners would have benefitted of first gaining the concrete experience of breaking up numbers into multiples of tens and units and then linking it to the 100-chart. The focus learners struggled when they had to apply this knowledge to the completion of the exercise in their workbooks.

I eventually assisted the focus group at the tables using flard[12] cards linked to the concrete apparatus. Each learner had their own flard cards. While flard cards are used to teach place value, they can be used successfully to aid in the building up and breaking up of two digit numbers to facilitate the solving of addition and subtraction sums. L, K, M and R quickly mastered the concept of adding and subtracting the multiples of ten from a two digit number. Learner A had no concept or understanding of bigger numbers and still experienced difficulty with the number concept of numbers in the number range 0-10.

During a follow-up lesson the following day, the teacher again uses the 100-chart while giving individual learners the opportunity to add and subtract multiples of ten from any number. The learners struggle as they have no experience of the quantity of the numbers that they are using.

When the focus group learners are sent to their tables to complete an addition and subtraction exercise with multiples of 10 (e.g. 43 +10 =; 57 + 20 =), R falls back to the concrete and Z only completes three of the sums. L, K and M seem to understand what they are doing. M uses the 100-chart successfully and L and K are able to complete the sums without using any aids or tools.

The teacher conducted the following assessments to evaluate progress and ascertain whether individual learners in her class had mastered the concepts taught in the area of mathematics and number concept development. Please note that the assessment codes reflected are as prescribed by the National Department of Education (South Africa, 2002).

The assessment task consisted of: Fill in the missing numbers while counting in tens; count the blocks (in groups of ten), write the number and fill in how many tens are in that number – Learners were provided with a picture representation of the numbers 15, 13, 12, 11 and had to complete the number of tens and ones; Place value e.g. 79= 70+9 and calculations e.g. 34+20 (See appendix L).

Assessment rating and difficulties of learners in the focus group:

A- 1- Not achieved – He experienced difficulty with everything.

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[12] Flard cards are cards numbered from 1-10, multiples of 10, 100, 1000. The cards fit on to one another to build or break up numbers e.g. 25 would consist of a 20 card and a 5 that fitted on top of the 20.

Z- 4- Outstanding – He struggled with the picture representations of the blocks of ten.

K- 4- Outstanding – He struggled with the picture representations of the blocks of ten.

M- 2- Partially achieved – She experienced difficulty with counting in ten's and calculations.

L- 1- Not achieved – This is very surprising. He always seems to know what is happening when asked mentally. He experienced difficulty with place value and calculations.

R- 1- Not achieved – Difficulty with everything. I suspect that he does a lot of surreptitious copying when completing activities in his workbook.

(Excerpt from Journal 1: 8 September 2009).

Some of the focus learners experience difficulty as a result of possible developmental delays, but from the above assessment, it is apparent that the learners had not mastered the concepts and were not successfully able to complete the assessment without the assistance of concrete and other apparatus. Z, while almost never completing tasks due to difficulties in the areas of gross and fine motor, seems to have mastered the concepts. K mostly performs well when he is coping emotionally and also has a good number concept.

The teacher now moves on to the teaching of analogue and digital time, followed by halving. Learners learnt how to halve numbers with the teacher demonstrating how to halve to them. They then followed the semi-concrete method and subsequently the abstract method that the teacher had practised with them.

T asks halving (0-10) as mental maths. Learners use their fingers to work out – putting fingers of the two hands together starting at the pinkie.

T draws the following activity on the board. 1 F =½
2 O |O =1
3 OF O = 1½
She writes down the numbers to 10 and learners must complete the activity in the same way.
(Excerpt from Journal 1: 9 September 2009).

Please note that the circles are a semi-concrete representation of counters. The F represents a counter that has been shared in half. The drawing of O |O represents two counters that have been shared between two people with each receiving one of the counters. The OF O drawing represents three counters that have been shared between two people with each receiving one and a half.

While a certain amount of teaching is required when a new concept is introduced during a mathematics lesson, the teacher should plan activities that allow for the learners to experiment and discover on their own while facilitating the learning taking place. The educational theories of Vygotsky and Feuerstein as contained in the NCS support this strategy of guided self- discovery and learning while interacting with materials and other learners. In the above extract from the lesson about the concept of halving, learners copied what the teacher demonstrated without any real understanding of the concept. They regurgitated the method taught.

During a follow-up lesson the learners practise how to halve by memorising and working it out on their fingers. Two learners work together. They form the number asked by touching their fingers together starting with the small finger. To halve the number six, each learner touches a finger of a friend, joining hands starting from the small finger counting until they have six fingers together. Each learner has three fingers touching the three fingers of their friend. To halve, they remove their hands from one another and count how many fingers on their hand had touched the friend's fingers.

The teacher teaches the learners to use the following method to halve numbers bigger than 10.

```
 13            14

 / \           / \
10+3
_+_=_
```

(Excerpt from Journal 1: 9 September 2009)

When I questioned the focus group most of them had no idea that what they were doing was actually halving the number. They did not make the connection between the concrete, semi-concrete or abstract method. They just followed what the teacher told them to do without any real understanding. They learnt halving by rote. I then gave them concrete material and went over the concept of what halving actually is. They had a good understanding of the concept at the end of the lesson. Two of the focus group learners were able to transfer the knowledge that they acquired during the concrete session over to the abstract solving of a halving problem. Most of the focus group learners have poor memory skills as well as poor attention skills. They learn better by being able to experience the concept for themselves within a meaningful context.

After the lesson on halving the teacher quickly revises arranging numbers from big to small and small to big. She indicated that she had taught this skill earlier on in the term. The learners are then required to complete an assessment task that consists of exercises on place value, halving and sequencing. (See appendix J).

Assessment ratings and difficulties of learners in the focus group:

Z- 2- Partially achieved: He struggles with arranging numbers from big to small, small to big as well as halving.

M- 3- Satisfactory achievement: She struggles with arranging from big to small, small to big.

R- 1- Not achieved: He struggles with everything – He can draw the halving problem, but cannot write down the answer. Marks are only given for the written answer.

K- 1- Not achieved: He can halve, but does not understand the method. He also struggles with arranging the numbers from big to small and small to big.

A- 1- Not achieved: He does not have a clue.

L- 3- Satisfactory achievement: He struggles with the arranging of the numbers.

(Excerpt from Journal 1: 9 September 2009).

My question here is what constitutes as success. R and K can do halving, but because they did not follow the method, did not get the mark. L has mastered the methods and is able to use them. Most of the learners in the class (not just the focus group) had forgotten how to sequence numbers. There is some question in my mind whether they had actually been allowed to master the concept prior to the assessment or whether it was merely one of those last minute additions to the assessment to round it off.

The next assessment task consisted of the completion of number patterns and calculations with two digit numbers.

Assessment ratings and difficulties of learners in the focus group: (See appendix K)

L- 3- Satisfactory achievement: He struggled with some of the number patterns and subtraction e.g. 45-3

K- 4- Outstanding: He could do everything.

A- 1- Not achieved: He had no idea of number patterns or calculations

R- 1- Not achieved: Poor number patterns and calculations

M- 2- Partially achieved: She experienced difficulty with number patterns

Z- 4- Outstanding (Excerpt from Journal 1: 9 September 2009).

Learners L, K and Z have mastered the concepts taught. I find it interesting that M, R and A all experienced difficulty in the area of the completion of number patterns as well as difficulty with the solving of calculations. Number patterns assist learners with basic calculations (Jordan et al., 2006:155; Frobisher et al., 2002: 244; Anghileri, 2002:3). It stands to reason that therefore learners who experience difficulty with number patterns are likely to experience difficulty with basic calculations.

5.2.2.2 Action research cycle two

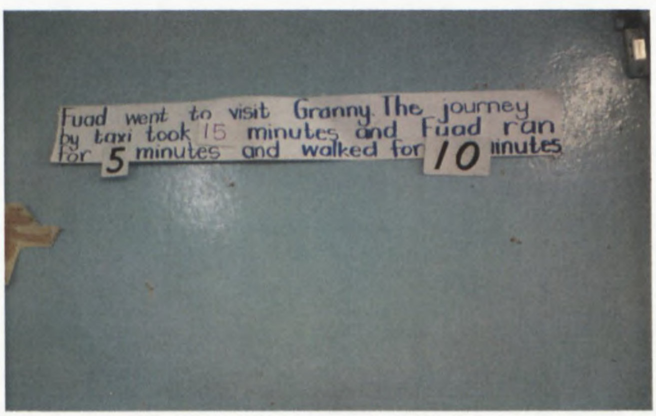
I will now discuss how learners acquired calculation skills during action research cycle 2 which took place in January 2010.

During these sessions, the learners (whole class) were consolidating calculation work already mastered in grade 1. The teacher wrote bonds of e.g. 6 and 7 on the board. The learners completed the work in their workbooks. They then copied the work into their homework books to practise again at home. The next morning the whole class came together on the mat and individual learners provided the answers to the previous days work and homework, which the teacher then wrote on the board. The learners marked their own work at the tables and did their corrections copying the correct answers from the board. I observed learners using their fingers to work out answers, remembering and just filling in answers, copying from others, using other learner's fingers to count, sharing answers and just filling in anything as quickly as possible to rub out and replace it with the correct answers from the board the next day. The last two strategies were mostly implemented by the weaker learners. From my observation of the above, it was clear that although the majority of the learners had mastered the bonds successfully, a large number of learners in the class had not.

It was evident from observation of the strategies implemented by the weaker learners in particular that they did not as yet have an understanding of the concepts of addition or subtraction and were merely trying to keep up with the class by any means possible. The above practise and drill strategy did not assist them in acquiring the necessary concepts. Some of the weaker learners practised at home and came to school with correct answers that it would seem had mostly been provided by the parents as the learners still could not do the work required in the classroom. In my opinion these exercises did not benefit the weaker learners in any way.

While drill work and repetition have its place in the practising of bonds, there are various more interesting and effective teaching strategies that could have been used to enable learners to master their bonds. Even though the teacher was doing revision of work supposedly mastered in grade 1 and therefor whole class teaching could be implemented, the teacher should thereafter have implemented differentiated teaching in groups to allow learners who had not yet mastered the concepts to have the opportunity to do so. The learners who had mastered the concept could then have revised their bonds by means of games, flashcards and problem solving. (South Africa. NDE, 2002:20).

I worked with the weaker learners at the tables and allowed the learners to make use of concrete equipment to work out calculations. Most of the learners in the weaker group were still on the all count level. Learners moved from all count to counting on by putting one number in their head and counting on using concrete equipment. There is progression in the way that learners acquire skills to learn to solve basic operation problems. The above teaching strategy should be linked to the use of number-lines and number charts to help learners to visualise the strategy (Hopkins et al., 2001: 18).



The teacher started to do daily word sums with the learners. The learners were encouraged to find the shortest method to come up with a solution to the problem. Most of the learners started out by drawing pictures to represent the calculations, but soon afterwards they were all just writing number sentences to show their answers. This demonstrates that the learners were able to interpret the word problems, reason about what was required mathematically to solve these problems and translate the problems into symbolic mathematical equations. The learners discussed their solutions and explained how they worked out the solution to the problem.

The teacher used the same structure of word problems and just substituted the numbers.

> In school, students are given specific problems to solve, but outside school they encounter situations in which part of the difficulty is figuring out exactly what the problem is. Therefore, students also need to be able to pose problems, devise solution strategies, and choose the most useful strategy for solving problems. They need to know how to picture quantities in their minds or draw them on paper, and they need to know how to distinguish what is known and relevant from what is unknown (Kilpatrick et al., 2001:13).

Learners should hence be exposed to a variety of different types of word problems to encourage mathematical reasoning and allow for exposure to different methods through which to solve problems.

5.2.2.3 Final assessment

The following excerpt from the mark schedule of the grade 2-class for term 1 – 3 (2009) was modified to protect the anonymity of the learners in the focus group. It reflects the progress of the focus group learners over a period of three school terms. The action research intervention was conducted during the period of the third term.

Table 5.1: Excerpt from mark schedule: grade 2, 2009.

Name	Term 1	Term 2	Term 3
Learner L	1: Not achieved	2: Partially achieved	3: Satisfactory achievement
Learner M	1: Not achieved	1: Not achieved	1: Not achieved
Learner R	1: Not achieved	2: Partially achieved	2: Partially achieved
Learner A	1: Not achieved	1: Not achieved	1: Not achieved
Learner K	1: Not achieved	3: Satisfactory achievement	3: Satisfactory achievement
Learner Z	2: Partial achievement	2: Partial achievement	3: Satisfactory achievement

The following can be concluded from the above table 5.1:

Learner L has shown consistent progress during the three terms. During my observation of him, it was noted that he had a growing perception of number concept and was able to verbally explain how he had completed a specific problem.

Learner M experienced difficulty in mathematics throughout the three terms. She operated on a concrete level and was not able to complete activities without using concrete materials. While she memorised some of the bonds of ten, she had no clear understanding of the underlying basic concepts. She spent more time in the grade 2 class during the following year and was thus present during action research cycle 2. During the second research cycle it was pleasing to note that she was able to move on from using the concrete materials to more abstract forms of reasoning.

Learner R, while initially showing improvement, seemed to be able to express himself verbally better than during the formal assessments. During the observation period, I noted that he had mastered certain concepts, but that he was not able to express this on paper during the formal assessments. I also surmised that he could have been surreptitiously copying answers from other learners in the group in order to finish tasks as quickly as possible. There are several factors which have impacted upon his progress in mathematics, namely, frequent absenteeism, short attention span and work avoidance tactics. He spent more time in grade 2 the following year.

Learner A made almost no progress during the three terms. The teacher moved him to an even weaker group of learners during the third term. This learner has subsequently been assessed by a clinical psychologist and placement at a special school has been recommended. He spent more time in grade 2 the following year and then made some progress in the mastering of calculations. He was also more task orientated.

Learner K's performance in class was erratic. His emotional outbursts and attention seeking behaviour often disrupted the teaching process. K has great potential and is able to perform during assessment situations. It is difficult to ascertain whether he has mastered a specific concept when he exhibits a lack of cooperation during classroom activities. He, however, performs well during formal assessments.

Learner Z showed improvement during the action research intervention period in term 3. He mastered the concepts, but found it difficult to put his knowledge to paper. Z exhibited work avoidance tactics when it came to the writing down of answers and the completion of tasks. He experienced difficulty with the organisation of his workspace, writing in lines and the organisation of his activity. He seldom completed tasks. During the formal assessment task, he had no option, but to complete. The teacher allowed him sufficient time to write down his answers. As a result, his assessment code shows improvement in the third term. He had the knowledge, but was hampered by his inability to put it down on paper.

5.2.2.4 Critical reflection

The learners in the class again used memorising, copying and rote practice methods to master addition and subtraction. Again most of the learners in the class were able to complete their exercises without any help. I am not able to ascertain whether they used a mental number line to work out the answers or whether they had simply memorised the answers. When the numbers became bigger some of the learners fell back on to concrete and used their friends' fingers to help count when they ran out of fingers.

Two of the focus group learners had no understanding of the concept of addition or subtraction. Most of the focus group learners were able to use either their fingers or concrete equipment to work out the answers of their addition sums once they understood the concept of addition. Learners K, Z and L showed progress in their number concept development as reflected in the classroom assessments conducted by the teacher as well as the improvement since the beginning of 2009 as reflected in the mark schedule of that specific class.

The positive development in how learners acquired calculation skills was the apparent ease with which most of the learners in the class were able to make the transition from first solving word problems using drawings and the quick progression to being able to formulate their own number sentences while solving problems.

5.3 Which teaching strategies are currently used to support the acquisition of number concept skills in a grade 2 class in Manenberg?

In this section, I will discuss the teaching strategies, **as observed** during action research cycle 1 (June 2009) and action research cycle 2 (January 2010) to teach the superordinate concepts of number development.

5.3.1 Counting

The teachers used the following **teaching strategies** to teach the subordinate concepts of counting:

- Conservation of number
  - I did not observe the teacher developing this particular concept in learners.

- Counting by rote:

    - The teacher pointed to a number chart and the learners counted. She often allowed individual learners to use the pointer to guide the rote counting. Learners practised to count on and back from a specific number. They also had to practise for homework. **Teaching strategies used: Look and say, memorisation.**

    Rote practise or memorisation of specific number skills facilitates procedural fluency and competency. In the above exercise the rote strategy was coupled to a visual aid, namely a 100-chart. This added meaning to what the learners were doing and helped the learners to visualise the counting process, assisted with the identification of numbers, the sequencing of numbers and the forming of mental number-lines. It is however, important that the teacher only use this method to consolidate the concept after learners have formed a prior understanding of what counting is and why we count. Rote practise even when linked to the 100-chart can be a meaningless repetition of numbers if the learners do not have an understanding of the underlying concept taught. Being able to form a mental number-line is an essential tool in the development of number concept and assists with a greater understanding and procedural fluency in the solving of arithmetic problems.

- Counting one-to-one correspondence:

    - The learners in grade 2 can already count one-to-one correspondence and practise using their fingers and counters. They are not specifically taught this skill in grade 2, but should be able to count out a 100 objects successfully. The teacher only practised up to 30 objects as she did not have enough counters and the learners often had to share. **Teaching strategies used: Concrete apparatus, cooperative learning.**

    While cooperative learning during counting is a useful strategy and learners check and correct their friend's counting and as a result then have extra opportunities to share, learners should rather be allowed to each have the opportunity to manipulate the concrete apparatus on an individual level, before asking a friend to check. Learners need a concrete understanding of counting one-to-one correspondence to enable them to master the secondary skills such as quantity, comparison of numbers and sequencing of numbers. These are all skills essential for the development of number concept.

- Estimation:

    - The teacher taught estimation only on one occasion during action research cycle 2. She filled a try with a variety of objects and asked the learners to estimate how many items were on the tray without counting them. She then covered the tray with a cloth and the learners had to give their answers. They then counted the objects by grouping them into groups of 10 and checked whose answer was the nearest. **Teaching strategies used: Visualisation, concrete apparatus.**

      As previously discussed in this chapter, estimation is a very valuable skill in the development of number concept. The focus of the lesson was visual memory rather than estimation. The teacher should have used the same objects instead of a variety of objects. Learners recalled the variety and therefore were able to count rather than estimate.

- Counting in multiples

    - The teacher used a 100 chart to teach learners to count in multiples of 2, 3, 4, 5 and 10. She pointed on the chart and used counters to mark the next multiple so that the learners could also see the visual pattern. The teacher also encouraged learners to keep the multiple in their head and count on softly on their fingers in the interval of the multiple saying the multiple factor loudly. The teacher also practised with the learners to memorise the counting in multiples. **Teaching strategies used: Look and say, visualisation, counting on, developing a mental number-line, memorisation.**

      Rote counting practise of multiples, while assisting with the later on memorisation of the multiplication and division tables, is meaningless if the learners have not had the opportunity to experience counting in multiples in context using concrete apparatus. The linking of the exercise to the 100 chart is meaningful as it assists learners in forming a visual 'picture' of the number pattern and assists with the development of a mental number-line. The teacher allowed for concrete experience as learners used their fingers, but once again it was merely a repetitive method in a whole class situation. While consolidation of counting in multiples could form part of the mental maths sessions with the whole class at the beginning of the maths lesson, the concept is better taught in small group sessions where learners have the opportunity to handle concrete equipment.

- Sequencing of numbers
    - Some of the learners were chosen to assist with this exercise. They were given different numbers on cards and then had to be put in sequence from the person with the biggest number to the person with the smallest number. The teacher asked questions such as which number is the biggest/smallest and which number came in the middle? Here the teacher used the abstract number cards coupled to the concrete physical bodies of the learners. **Teaching strategies used: Concrete linked to abstract, developing a mental number-line.**

    This exercise was a very effective way to teach sequencing as it was taught in a context that the learners experienced daily when lining up in rows to lead to the playground etc. Biggest and smallest, however, refer to comparison of numbers. Comparison of the size of numbers should be taught in a concrete manner with learners matching and counting who has the most/least objects and how many more/less do they have. Learners can only arrange numbers from big to small or small to big after they have understood the concept of the quantity of the numbers that they are working with and are able to compare these quantities with one another.

- Numbers and number names
    - The teacher asked learners to identify numbers on the 100 chart. They practised to write the numbers and number names by copying from the board. The teacher writes the number names from 1 to 10 on the board. **Teaching strategy used: Transcription**

T writes the following activity on the board.
Number names

61 sixty one	*66*
62	*67*
63	*68*
64	*69*
65	*70 seventy* (Excerpt from Journal 1)

Transcription in this instance is used to practise the spelling of the number names. It is a rote exercise that relies on memory. Simply copying the words from the board is a meaningless exercise with very little value. The learners should be encouraged to read and spell the number names from one to ten as well as in tens to a hundred as part of literacy lessons and as part of homework practise. The writing of number names could then form part of a counting exercise in the class as well as the following of instructions in literacy. Learners could be given a list of items to count in the classroom e.g. the number of windows, chairs, tables, etc. Learners could be encouraged to write the numerals as well as the matching number names. This makes the practise of the writing of number names more meaningful. Bingo games where learners cover the number names taught or lotto games where learners match numerals to number names can also be used to consolidate this skill with more enjoyment.

5.3.1.1 Critical reflection

The teacher uses drill work, rote teaching and the memorising of methods to teach number concept development. These methods do not always facilitate a true understanding of the concept as the learners repeat the information in parrot fashion without any real understanding or thinking required where they have to apply the concept. The weaker learners learn and remember better when allowed to use concrete equipment. These learners have weak memory skills and are still need the practical experience to facilitate understanding of concepts.

The constructivist theories of Piaget, Vygotsky and Feuerstein that underpin the NCS Mathematics requires that learners develop critical thinking strategies through mediated learning during interaction with the teacher, other learners and resource materials, while engaged in meaningful problem solving activities (South Africa. NDE, 2002:1). The rote teaching strategy consists of the repetition and memorising of facts and does not allow for the development of critical thinking abilities.

Unfortunately there is not enough concrete equipment for all the learners. A majority of the learners in the school receive social grants and very little school fees are paid. This has an impact on the teachers' resources that can be supplied. Counters are, however, easy to procure as a number and variety of objects such as bottle tops, ice cream sticks, stones, sticks, leaves, etc. are readily available. The learners can also use their body parts and those of their friends to aid in their counting. The teacher did not feel confident to allow the weaker learners to work with counters at their desks for several reasons:

- Learners took counters home and lost them;
- There are a lot of learners in the classroom and counters fell and rolled around creating a disturbance.
- The teacher wanted to encourage learners to move away from the concrete to the abstract.

While all of the above are valid reasons, learners should have ample opportunity to master concepts using practical equipment if they still need to and there should be enough counters for the individual learners to use.

5.3.2 Calculations

The FfL campaign (South Africa, 2008:16) urges grade 2 class teachers to spend at least 10 minutes daily on calculations as part of oral mental maths and the development of number concept through the solving of problems. Learners often experience difficulty in the mastering of basic computations as they do not have a good understanding of the number concept underpinning this skill and have been taught to memorise the procedures and answers. Learners then resort to using any basic operation to solve a problem without understanding what is required, often not even being able to remember what the different symbols mean (Anghileri, 2002:1).

The teacher used the following teaching strategies to teach the subordinate concepts of calculations:

- Basic Operations
    - The teacher did not initially allow learners to use concrete equipment to work out their answers, but realised that some learners were just not developmentally ready to work out the answers in the abstract. She then allowed the weaker learners to use concrete apparatus at the tables when completing their basic operations exercises. Some learners were using their own and other learner's fingers to count out the answers. **Teaching strategy used: Concrete apparatus.**

      Most of the learners in the focus group and in the class function at the concrete operational stage (7-11 years) as identified by Piaget. During this stage, learners should be able to think and reason logically about objects and events that occur within their domain (Atherton, 2005:3). Learners should consequently be allowed to utilise concrete apparatus to assist with basic operations if they still have not mastered the concept fully, but should be encouraged to move on to the semi-concrete approach and finally the abstract level of problem solving.

- The calculation exercises were written on the board or on worksheets and learners copied it down into the workbooks and filled in the answers. The same sums were practised for homework. The next day the teacher asked individual learners to give the answers to the sums and she wrote it on the board. The learners marked their own work and copied the correct answers from the board. **Teaching strategies used: Talk and chalk, transcription, Drill work at home.**

  Rote teaching strategies does not motivate learners to think and reason mathematically. Learners should have a good understanding of numbers and be able to manipulate numbers before teaching computations (Frobisher et al., 2002:143; Anghileri 2002:1). While drill work and transcription are used to consolidate and practise calculations, the purpose could be better served by using games and completing problem solving exercises to provide context and make the activity more enjoyable and meaningful to the learners. This would encourage learners in their development of number concept.

- When a new number was introduced, learners were encouraged to break down the number into groups or multiples using concrete apparatus and flard cards. The teacher also used money to teach the learners the concept of equal to. **Teaching strategy used: Breaking up and building up of numbers.**

  The above strategy is very valuable for the development of number concept in learners. Learners gain experience in the manipulation of numbers as well as the value and comparison of numbers. This activity, when effectively implemented, facilitates learners' understanding of the concept of numbers.

- The concept of halving was taught, first concrete and then using a specific method, but the learners were never exposed to how to apply this knowledge in problem-solving. **Teaching strategy used: Rote method.**

  Rote teaching of the concept of halving does not allow the learners to gain an understanding of the concept as they are merely memorising and copying. Learners are consequently not able to apply the knowledge in real life contexts.

- Addition and subtraction of two-digit numbers was introduced by the adding and subtracting of the 10. Learners used the 100 chart and multiples of 10 to work out the answers. **Teaching strategy used: Counting on**

  Counting on is a skill that learners must master to enable the addition and subtraction of smaller numbers with ease. As a strategy taught to the learners, counting on is a vital skill to acquire as the second step to develop when working with numbers (step 1: all count) in the solving of basic arithmetic problems. The 100 chart facilitates this process and assists learners in the addition and subtraction of the 10 by using the multiples of ten as displayed on this chart.

- The teacher used the problem-solving approach with word problems to encourage learners to apply their arithmetic knowledge. She used the same type of word problems continuously and the learners quickly mastered the pattern of how to solve them rather than using their cognitive thinking skills in the application of knowledge. **Teaching strategy used: Repetition/ rote**

- The teacher also utilised **differentiated teaching** in groups as a teaching strategy, as she worked at a slower pace with her weaker learners through the number concept exercises.

5.3.2.1 Critical reflection

While the teacher used different teaching strategies to teach calculations, she still depended on rote, drill and the memorising of methods to develop the learners' number concept in the grade 2 classroom in Manenberg. This does not necessarily facilitate the development of a true understanding of calculation. Learners who merely memorise addition and subtraction bonds without any real understanding are not able to transfer the knowledge to successfully solve number sentences and word problems using bigger numbers.

5.4 Concluding remarks

In an attempt to critically analyse the teaching and learning of number concept in a grade 2 class in the Western Cape, I have come to the following conclusions:

- Grade 2 class children learn best when they are exposed to the concept initially through a concrete approach then, followed by semi-concrete and finally abstract levels.
- While rote practising teaching methods have their place, it should always only be utilised as consolidation after the learners have acquired a true understanding of the concept taught.
- Teachers should be encouraged to utilise a variety of teaching materials and teaching strategies to allow all learners the opportunity to master the concepts taught. The teaching materials and strategies should facilitate the development of a greater understanding of number concept. Teachers should be encouraged to move away from chalk and talk teaching methods to facilitation allowing for problem-solving and experimentation.
- Number concept development has a certain progression of concepts and should not be approached in an indiscriminate manner. It should rather be approached in a way that encourages the building of base concepts following a systematic progressive pattern of skills and approaches that could then be expanded to include bigger number ranges.
- Differentiated teaching does not just mean teaching in smaller groups. It requires group teaching incorporating different teaching strategies to reach individual learners, instruction determined by the developmental level of each group and assessment where all the groups some more than others, will be able to complete most of the tasks required with some success.
- Teaching time in mathematics lessons should be planned and properly utilised to allow for the practicing of different skills whether mental, verbal or written.

5.5 Summary

In this chapter I have endeavoured to answer the research questions pertaining to the critical analysis of number concept development in a grade 2 class in the Western Cape. I have identified how learners currently develop number concept and which teaching strategies enable learners to develop their number skills.

Chapter 6 will contain reflections on other data collected during my observations in the mathematics lessons and my recommendations for further research in the area of number concept.

CHAPTER SIX
OTHER FINDINGS AND RECOMMENDATIONS

6.1 Introduction

Chapter 6 includes my reflections regarding **systemic problems that have an impact on the teaching of mathematics** at the school that denotes the site of research. These reflections are based upon observations made during the mathematics lessons in the grade 2 class. Areas under discussion includes: the school, classroom, teacher, parents and learners of the focus group. Also included in this chapter are my recommendations for areas of further study in number concept development.

6.2. The School

I will now discuss various systemic problems that impact on the teaching of mathematics in the school.

6.2.1 Findings

Mathematics teaching time is wasted due to interruptions of the instructional time. Most of this does not fall into the realm of the teacher's control. When teachers are absent, the participant teacher as the HOD has to divide the absent teacher's learners among other classes. The participant teacher is also the collection point of all monies for the teachers who fall under her supervision. The mathematics time is further interrupted by parents who come to the classroom to speak to the teacher first thing in the morning as well as requests from other teachers.

During the action research cycle 2 in January 2010, the learners went out to the field in the morning to practise athletics. This had an effect on the whole teaching day and not just the mathematics instructional time as the learners were hot and tired after the practice and not interested in school work of any kind.

The photocopy and risograph machines often break down and then the teacher cannot make photocopies before school. The participant teacher then has to leave the classroom to go and photocopy worksheets for the learners.

Mathematics instructional time is often disrupted by the school bell that does not ring on time. The assembly period one morning a week if often extended due to circumstances such as visitors to the school and this has an impact on the mathematics period on that day.

In a survey conducted in Canada it was found that the most frequent sources of interruptions were identified as the school intercom, message delivery, unspecified visitors, other teachers, other students, parents and the telephone. More than half the teachers who took part in the survey considered the interruptions as a serious problem as it had a negative effect on mathematics teaching time (Leonard, 2001:107-108).

6.2.2 Recommendations

The school should implement a policy to deal with teacher absenteeism. Teacher absenteeism does not only affect the instructional time of the participant teacher as HOD, but also has a knock-on effect on the classes of the other teachers as the absent teacher's learners presently have to be accommodated in other classrooms for the duration of the school day.

At present, due to the unique circumstances of the school, the money collection cannot be changed, but should be reviewed in future. The school could consider starting 15 minutes earlier in the day to facilitate the collection of any money.

The participant teacher, who is also the HOD, has already put measures into place to curb unnecessary interruption of her mathematics instructional time by other teachers.

The school has a policy for dealing with parental visitation, but this is seldom followed by the teachers and parents alike. The management of the school must revisit the implementation of this policy and see how it can be improved upon.

The school has one photocopy machine and two risographs that may be used by the teachers to photocopy worksheets. The participant teacher should plan ahead so that she is able to make the necessary photocopies a week or a couple of days in advance. This will negate her having to leave the classroom to go and photocopy resulting in the loss of instructional time.

The school has the necessary equipment to link the school bell to a computer system so that it rings on time. The management of the school must undertake to have this system implemented. When the school has visiting groups from outside who take part and attend the assembly period, it does happen that the assembly time is extended, but the management of the school should guard against this becoming the norm.

6.3 The classroom

Here I discuss the systemic difficulties that impact on the teaching of mathematics in the classroom.

6.3.1 Findings

As mentioned in **Chapter 4**, the school consists of prefabricated buildings and the classrooms were initially built to allow for the teaching of 30-35 learners per classroom. There are currently 40+ learners in a classroom and that means that there is not enough space to allow freedom of movement between learners. Not only does this make it very difficult to assist individual learners at their desks with their work during maths lessons, it also makes group interaction very noisy and there is not enough space for groups to work on together while exploring problem-solving situations using concrete apparatus. The small physical space filled by too many learners has a negative impact on classroom management. There is also not enough space to pack and store LTSM.

6.3.2 Recommendations

The current schools were built as an interim measure until the buildings could be replaced by brick buildings. The buildings require constant maintenance and repair and application should be made to the WCED to fulfil promises made many years ago. The current legislation allows for a ratio of 1 teacher to 39 learners. The number of learners in a school has a direct impact upon the teacher allotment for the school. The management of the school should review the learner allocation and ensure the equity of learner allocation between phases and grades.

The management of the school should also investigate options for easy access and storing of LTSM in the foundation phase classes or another secure venue.

6.4 The participant teacher

Here I discuss how the knowledge and teaching of the participant teacher impact upon the teaching of mathematics in the grade 2 classroom.

6.4.1 Findings

The participant teacher has been teaching in the foundation phase for approximately 12 years in total. She is trained to teach senior primary and high school learners. On more than one occasion, the teacher expressed that she lacked confidence and felt insecure both in a management as well as a class teacher position. Even though she felt insecure, the teacher presented a positive attitude towards the research process and the teaching of mathematics. The teacher asked questions and was eager to learn and implement new ideas. The number concept knowledge of teachers as well as their attitude to the teaching of mathematics influence their planning and teaching (Yang et al., 2007:383; Mooney et al., 2003:20).

6.4.2 Outcome

The teacher has enrolled to complete her Advanced Certificate in Education, Foundation Phase, at the Cape Peninsula University of Technology (Mowbray). To my mind, this has been the best result of conducting my research study at the school. The teacher has grown in confidence and holds workshops to train the teachers placed in her care. This has had a positive outcome for the school as well as the teacher and her learners.

> A teacher's sense of wellbeing and success within the classroom climate, not only has a positive effect on the student outcomes, but on their own perceptions and motivational strategies contributing to improved effective outcomes and goals (Newman & Way, 2009:413).

6.5. The parents and learners of the focus group

I will now discuss the influence of the parental support upon the learning of the learners in the focus group.

6.5.1 Findings

During the classroom sessions while working with the focus group learners I observed that some of the learners needed intervention from medical and other professionals. One of the learners had a history of eye operations, another, anaemia and yet another presented with characteristics of gross and fine motor difficulty. One of the learners displayed the characteristics of possible attention deficit syndrome. Some of the learners in the focus group were often absent for extended periods of time. Most of the focus group learners received very little or no parental support and seldom completed homework exercises. Recommendations from teachers were seldom followed.

6.5.2 Recommendations

The class teacher should refer the learners in the focus group to the ILST for further discussion and referral to other professionals such as ophthalmologists, paediatricians, physiotherapists and psychologists. The parents of the learners should take responsibility for the physical interventions needed and should be encouraged to make regular contact to discuss their learner's progress with the class teacher. The parents should also undertake to conduct daily homework supervision and ensure that learners attend school on a regular basis. Authorities should implement a more drastic approach to compel parents to take responsibility for the education of their learner.

6.6 Conclusion and recommendations for further research

This chapter provides the final findings and recommendations in the critical analysis of the development of number concept development in a grade 2 class in the Western Cape. While there are many areas in the field of number concept development in which more research is required, I would like to recommend that the following areas be considered:

- The collation of a definition of number concept (as discussed in **chapter two**).
- The impact of socio-economic conditions upon the development of number concept (as discussed in **chapter two**).
- The development of an effective teacher training programme for the development of number concept.

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APPENDIX A: WCED letter of permission

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ISebe leMfundo leNtshona Koloni

Mrs Marie-Louise Scholtz
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Dear Mrs M. Scholtz

RESEARCH PROPOSAL: A CRITICAL ANALYSIS OF THE TEACHING AND LEARNING OF NUMBER CONCEPTS IN A GRADE 2 CLASS IN MANENBERG.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **21st July 2009 to 30th September 2009**.
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr R. Cornelissen at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:
    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

APPENDIX B: WCED letter of permission

Navrae
Enquiries
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Verwysing
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Wes-Kaap Onderwysdepartement

Western Cape Education Department

ISebe leMfundo leNtshona Koloni

Mrs Marie-Louise Scholtz
B18 Fairglen Mews
Austell Road
HEATHFIELD
7945

Dear Mrs M. Scholtz

RESEARCH PROPOSAL: A CRITICAL ANALYSIS OF THE TEACHING AND LEARNING OF NUMBER CONCEPTS IN A GRADE 2 CLASS IN MANENBERG.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

12. Principals, educators and learners are under no obligation to assist you in your investigation.
13. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
14. You make all the arrangements concerning your investigation.
15. Educators' programmes are not to be interrupted.
16. The Study is to be conducted from **21st July 2009 to 26th March 2010**.
17. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
18. Should you wish to extend the period of your survey, please contact Dr R. Cornelissen at the contact numbers above quoting the reference number.
19. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
20. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
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We wish you success in your research.

APPENDIX C

Journal 1: Action research cycle July – September 2009

Wednesday, 22 July 2009 The teacher has the following charts on display in her classroom: • Number cards with dot representations: 1-20 • Wall chart with number, number names and picture representation: 1-20 • Timetables chart • Number line examples depicting four basic operations • 100 number chart • Colours • Months of the year • 3 D shapes chart • Doubling and Halving chart • Number names – 10 • Digital Time chart • Different examples of number lines on a chart – 10 • Length chart • Number names in tens to hundred • Counting in 4's chart	LTSM
Lesson of the day Counting: All learners sit on the mat and count together as a class while a learner points to the 100 number chart. All learners count in two's starting at the number indicated by the teacher. They count in two's from number one, three, etc. Group 1 and 2 get the opportunity to do this on their own with the rest of the learners observing. The whole class then count in fives starting at 1, 6, 11, 16, etc. Learners catch on to the number pattern quickly. Group 1 gets the opportunity to do it on their own and then the rest of the class.	My observation
Group 1 and 2 are able to count quite well in their groups, but group 3 and 4 have lost interest and do not present as learners who know how to count in multiples. The learners spend a long time on the carpet and become fidgety and look very bored. The weaker learners start to act out and the teacher has to reprimand Learner L. The teacher seems stressed by my presence in the classroom.	She asks the learners how to write 22 and they respond a two and a two
Activity: The whole class stays on the mat while the teacher writes the activity on the board.	Focus of my observation

The teacher asks the class what the date is and which number comes before and after the date. She then writes the numbers from 51 to 60 on the board and asks learners to copy and write the number names into their books. She writes in fifty one and sixty – so that the learner will know how to spell the words. Number names from 1-10 are on the board for reference Teaching Group 3: She then sends all learners to their tables to start the written activity. She calls group 3 to the mat with their flip file. The flip file has a 100 chart and number line to 30. This group is the focus of my observation. She instructs them to count in fives from number one. They use their 100 chart and count on 5 numbers from number one, using their fingers to point at the numbers. The learners say six, then count 1, 2, 3, 4, 5 to the next number, pointing with their fingers and say 11. They then repeated the exercise using fingers only. They count four numbers softly and say the fifth number loudly. The teacher asks individual learners to predict which number comes next and all of them could do it. She asks them to practice counting backwards in fives and from number two on in fives at home. The teacher informs me that on Monday they worked on the number 20 and that she was doing revision today. She asks the group which number comes before 20; which number is two numbers before 20; Which number comes after 21; How do you write 21. The learners promptly responded a 2 and a 1. She then asks which number is two numbers after 20. The learners seem stumped. She then asks if the number is going to get bigger or smaller. She repeats is 22 bigger or smaller than 20? The learners seem confused and she informs me that they the bigger and smaller concept needs practice, but that she would not be addressing that today. Learner K is now fidgeting and has lost interest. The teacher then proceeds to hand out twenty unifix blocks arranged in sticks of ten (two different colours) to be shared between two learners. The teacher asks the learners to put all the unifix in one long row of 20; What is half of 20? The learners break the row of unifix into two groups/sticks of ten and answer ten; They compare the two sticks to see that they are the same length; Double 10; Learners answer 20. The learners are then asked to organise their 20 blocks into groups of 2, 4, 5 and 10. Each group gets a different multiple. One learner does the grouping with the concrete apparatus and the other one must write what is happening on the little black board. Learner K now refuses to take part and the teacher later on tells me that he wants to work with	The learners do not understand that counting on makes more and counting back means less. I have given her my unifix from the MST kit to use so that she will have enough blocks next time Learners at the tables have finished their tasks and are becoming noisy. K is more comfortable with concrete than with abstract. How much is rote learning and how much is understanding? Group 4 is called to the mat and Group 1 and 2 are left to their own devices at the

the blocks and does not want to do the writing. Learner M and Learner Z: Learner M is very quiet and withdrawn. Learner Z groups the unifix blocks into groups of 4. Learner M writes 4+4+4+4+4=20. The teacher tells the learners to match the concrete blocks to what they have written to check if they have written correctly. They do. Learner A and Learner L: L groups the blocks into groups of 5. A writes: 5+5+5+5=20 Learner K and Learner R The teacher tells K that he has to take part and do the writing and not the grouping. R arranges the blocks into groups of 4. K writes 4+4+4. R checks K and matches the blocks to the writing. K then corrects and writes 4+4+4+4+4=20. The teacher writes the following on the board: 2 groups of 10 = She asks them how they can work out the answer. They tell her in chorus that she can double ten. She writes 10+10. She asks them how else she can write it and they chorus multiply. One learner in each pair writes the sum and the answer. Learner M writes 2x 10; 2 groups of 10 =12. She then checks and counts her blocks and corrects herself. The teacher writes 10x2=20 and 2x10=20. The teachers then talks to the learners about 4x5 being the same as 5x4. What can you tell me when you turn the numbers around? The learners chorus: the answer stays the same. Group 3 table activity: Group 3 returns to their tables and start to complete the number name activity from the board. The teacher walks around the classroom and checks the learners' work.	tables.
Seating arrangements: Right Left window 	All the learners are just copying the activity from the board and copying down the answers as well – pure transcription. None of the groups have follow-up activities to do. The boys interact with one another – interested in what the others are doing – M just ignores and continues

black board The six focus group learners are seated on the front right side of the classroom. Learner R and Learner K are sitting with their backs to the black board and are facing the back of the classroom. Learner L and Learner Z are seated on the right next to the window and have a reasonable view of the board. Learner M and Learner A are seated on the left side of the table and have to turn to look over their shoulders to view the board. The teacher has written the work on the far left side of the board.	
Learner Z: He is writing with an extremely small pencil. I ask one of the other learners if they don't have a pencil for him to borrow. His book is extremely untidy. He is able to write in lines, but struggles to control his pencil. The letters are all different sizes and are mostly too small for the lines. He has a correct pencil grip. He is right handed. Z seems to write by only moving the wrist and not the whole hand. It takes him forever to complete his work. He is also constantly distracted by what is happening around him.	The sharing of news gave me the opportunity to set up the life cam and my laptop. The learners initially noticed, but when teacher explained that it was just my computer, they ignored me. The teacher seemed more relaxed, but quite aware that I was conducting a video-recording.
Learner R: He is left handed and sits on the left with his back to the board. He finishes his work quickly and then takes out a book to draw in.	A feature of this lesson is the amount of times the lesson was either interrupted by circumstances, the teacher, visitors to the classroom etc.
Learner K: He rushes through his work and then takes out a book to draw in.	Why did the teacher not discuss the formation of the number pattern? What is the purpose of counting?
Learner A: He is distracted by K and R who have finished. He colours in the dots on his i. He eventually finishes and also shows signs of a short attention span. Learner M: She is a slow, but steady worker and perseveres neatly on. The teacher initiates a discussion, asking my opinion of what she taught group 4. I inform her that I was so busy focussing on my target group that I did not pay any heed. She seems relieved?????? I suggest that she can use buttons or counters to build the number pattern on the 100 chart while the learners are counting to also give them a visual representation. Z, M and A complete their work just in time. The lesson in now concluded 08:20-10:15.	It is clear that she loses Group 3 and 4 on the mat during the mat counting warm-up.

Monday 27 July 2009 – a video recorded lesson – using a life cam.	
Whole class activity: When I arrived in the classroom the learners were sitting on the mat telling their news and sharing their feelings. This lasted for approximately 20 minutes. The lesson then progressed into a maths lesson. The first thing I noticed was that the learners had now progressed to counting in fours. The teacher placed counters on the 100 chart to indicate the intervals. I don't know whether the learners assisted, or if this was done prior to the lesson.	She has virtually repeated Friday's whole lesson with them. I send my play money to her for future use.
One of the learners is pointing to the number chart with a stick while the others are counting in fours. They are revising. The teacher instructs them to say the numbers softly and the fourth one loudly. The learners repeat the instruction. Read every number and say the fourth one loudly. The learners count, but get confused: 4, 8, 11- some say 11 and not 12 – others say 12. The pointer loses where he is supposed to be. They start again from the beginning. The teacher asks: How do we write 36? The learners answer in chorus a 3 and a 6. The teacher repeats her instruction: I said every number softly, fourth one loud. Learner K is playing with his new pencil and eraser. Counting is interrupted again. L is fiddling, M is trying to count – the other members of group 3 have given up. The other learners are counting well now.	The learners needed a break at this time. She might have been better served had she taken them to the toilet between maths and news. The maths warm-up was also way too long – it was more like the teaching of a new concept to the class than a revision.
The teacher calls upon L to focus and count. She requests that only Group 3 and 4 count – they do this quite well reading off the marked number chart. Group 2 takes over at 36; Group 1 at 72. When the learners have finished the counting, the class is interrupted by a late arrival. One learner takes the opportunity to complain about a sore throat. The teacher separates L and K and informs them that they are not allowed to sit together. The counting continues. The learners must now use their fingers to count and say each fourth one loud. L is counting and K is playing with his pencil again. Teacher stops them and reminds them to touch each finger. They continue the process. The learners continue counting; M is taking part; A is trying. When the learners gets to 36 the teacher interrupts them again to reprimand a learner from not touching his fingers. The counting continues from 44. L and K have lost interest. M is counting looking at the 100 chart and not using her fingers. R has stopped counting; A is playing with his fingers. The teacher revises the sums that the learners did as part of the activity on Friday. The sums are still on the board. The learners are curious about what I am doing with the laptop. The teacher informs them that it is a laptop. She threatens	5c= _+_+_+_+_ 10c=5c+_+_+_ 10c=_+_ 20c=10c+5c+_+_+_ 20c=_+_ 50c=_+_+_ 50c=20c+10c+10c+_ 50c=10c+10c+10c+_+_

that if they don't behave that they will have no computer lessons on Wednesday. On Friday the teacher used the learner's tuck shop money to do money sums. The teacher points to the sum on the board. You have 5c – Break it up into smaller coins. The learners chorus 2c+2c+1c. Some of the learners are getting very restless. They have been on the mat for nearly 30 minutes inclusive of morning news time. The teacher asks: If I have a 5c coin and I ask you that you must give me change, but not a 2c coin. What will you give me? The teacher answers her own question. You are only going to give me 1c pieces. Give me 2 coins to make up a 10c. The learners seem increasingly distracted. A is picking his nose. – 5c+5c. I give you a 10c again – give me 2c coin; How many 2c coins are you going to give me? She puts 5 spaces on the board. The learners count 1, 2,3,4,5. The teacher increases the difficulty of the sums progressively ending with the equivalent to 50c. The teacher writes new, but similar sums on the board for today's activity. She informs me that she could not find her play money to teach the lesson. The learners sit and talk on the mat while the teacher writes the new activity on the board. She asks; what is today's date; yesterday's date; Today is...; and tomorrow will be... She asks who has seen 1c coins. One learner offers to bring in money for the learners to use in their sums. The teacher declines. She reminds them that on Friday they told her that you still get 2c coins and 1c coins. She tells them that she is going to give them 5c to break up into smaller coins. She writes the sums and explains them as she is writing. While she is busy A+ K are fighting and L is laughing at them. She tells the learners to give her the correct change or she will come to get change from them every day. If I give you a 10c, don't give me a 20c back. You must check that the change will make up the coin. The lesson is interrupted again by someone at the door. The learners seem progressively more disinterested. The learners have now spent 20 minutes maths warm-up and 20 minutes news on the mat. The teacher takes the class to the toilets. Table activity: Teacher checks while learners mark previous day's work and do their corrections. The class is interrupted again by a school assistant parent. The learners do the money activity that teacher writes on board.	T does not discuss the pattern formed? Learners don't handle concrete apparatus. Teacher asked learners to bring items from home for the class shop – they used it last week to practise addition and subtraction using money and the giving of change.

Group 3 Mat activity: Learners are called to the mat with their 100 charts. K immediately isolates himself from the group and sits away from the others on the edge of the carpet. The other learners sit in groups of two. T instructs them to count in two's while looking on their 100 chart while she is busy sorting out the rest of the class. R is not at all interested. The others count. T stops them and asks: How do we write 80? Learners answer an 8 and a 0. They continue to count in 2's till 100. T instructs them to count backwards in two's from 100. One of the girls leads the group and the rest tries to follow. T stops them at 80, 50 and 20. How do we write 40 – 4 and 0. K has now joined the group – sitting sideways – rocking. Teaching is interrupted by a learner looking for a pencil. T instructs learners to count in four's on their fingers – saying every 4th number loud. Counting is constantly interrupted by the teacher in order to help learners stay on the correct number. Continue from 20 again. K has now joined the group in the counting exercise. T gives each learner some buttons to pack on their 100 chart to indicate counting in four's. The rest of the class have now finished their activity and is very noisy. Most of group 3 pack their buttons by looking at the example 100 chart with counters stuck on it – copying and not actually exploring or counting for themselves. K puts his buttons on R's chart – does not want to take part. T speaks to him and gives him more buttons. L puts his buttons out – counting. M tries too. Z and R copies from the board. K tries on his own. A gets quite involved with the activity and seems to be concentrating hard. K helps R to do his and in the process rearranges the number grid paper which in turn moves all the buttons to the wrong position. He tries to rectify this. Class gets interrupted again by older learners with a message. Z takes all his buttons off – He is a procrastinator. T encourages him to do it again. T instructs them to count the number they put the button on loudly. Count in 4's. The learner's attention span is short – coupled with the constant interruptions – like liquid mercury. The rest of the class is very noisy. T instructs them to make own sums in their homework books. T again reprimands L for his short attention span. They count in 4's again. All pack away the buttons. Now they are counting on their fingers saying the 4th one out loud. T packs out unifix blocks in groups of 4 and demonstrates while all count. T instructs learners to count looking at her apparatus not the 100 chart. They struggle. She sends them to go practise – learn off by head – at home. Classroom very, very noisy. T complains about attention	My mom gives me a R10. I buy R__ burger, 50c sweets and R__ cool drink. How much money did I spend? Teacher is teaching another group on the carpet. The class is now getting very noisy. The T comes round to check on the learner's work.

span. Group 3 table activity Group 3 is sent to their tables to do the same money sums. Teacher reminds them that there are no 3c coins. She informs me that she cannot find her play money. The learners have to do the sums without any concrete apparatus – apparently they played with real money on Friday – don't know if they actually handled the money or only the teacher – while demonstrating. L plays the clown/Michael Jackson and dances the whole time – He is able to do the work and completes the task first. A and M count on their fingers and try very hard. A is lost. He puts on his specs when instructed. Z does the minimum and sharpens pencils, dances with L and generally procrastinates. R tries and succeeds to some extent. K goes missing when instructed to look for his spectacles and does not want to wear them. He ends up sitting in a corner behind the desk and does absolutely no work the entire time. **Tuesday 28 July and Wednesday 29 July – not able to attend lessons as I was absent** **Monday 3 August – recorded by life cam** **Whole class lesson** Teacher revises the money sums written on the board. She used the play money to explain shopping during the previous week. Again I get the impression that she only uses the concrete to demonstrate and that the learners don't really get the opportunity to learn through play or through interaction with hands on apparatus, games. She discusses all the sums completed as part of their homework exercise giving individual learners opportunity to answer mostly in chorus. R1,70=R_+50c+_ R1,80=R_+50c+10c+_ R2,20=R_+_ R2,70=R_+50c+_ R2,10=R_+_ R2,60=R_+50c+_ R1,20=R_+_ L is bored, yawns and plays with an eraser. When the teacher gets to the last sum, she says that she is quickly going to check with group 3 if they understood. T asks K how many R1 in R1, 20. He answers R1. She then asks L is that is correct. L answers R1. She then asks the rest of the class if they are sure that it is a R1 and not a R2. Teacher demonstrates by using play money to get learners to	T does not ask learners to work out their change from R10? The teacher has started to put up a number line in the classroom.

understand that there is a R1 in R1, 20 and not a R2. She asks them if R1, 20 is the same as R2, 20. The learner chorus says no. T asks how many R1 are there in a R2. T tells them that she would love to get change from them. If she gives them a R1, 20 and they then give her a R2, 20. How much extra would they be giving her? The chorus answers R1. Learners are told to do there corrections when they get to the table. The teacher asks for the date. Today is the third of August and yesterday was what ....Tomorrow is what..... T asks if they remember the story sum. The whole class reads the sum. T instructs the learners that they have to fill in their own amount and that it will not be the same as their friend's as they are going to different shops. Learners will not be able to cheat. All will buy 50c sweets. Must it cost more than R10 or less than R10? Chorus: Less – some chorus more. Who is going to give you the money if you don't have enough? Answer: My daddy – Your parents are not with you and those people are not going to give you the money if you don't have enough. You must make sure that you choose a cool drink and a burger that comes to R10 and not more than R10. It can be less. You can get change. T instructs learners to copy down word sum into their books and add in their own amounts. She demonstrates the number sentence on the board. R__+50c +R__=. Toilet break Group 3 Table Activity The learners do their corrections of the money sums – copying from the board and then they do the story sums using their own numbers. I assist Group 3 at the table. I bring the play coins to the table and allow learners to use it to work out their corrections. L is not feeling well and is lying on his arms on the table. K builds R2, 20 out of a R2 and a 20c. K writes down the story sum. M goes directly on with her story sum as she was absent the day before and missed out on the money sums. I have to remind A that he must copy down the story sum. He has just concentrated to finding an answer. Z sharpens his pencil for most of the activity time. M struggles with b/d/p. Z has still done virtually nothing. I help him to sharpen his pencil so that he can start. K finds his spectacles and Z is still sharpening – this time a colour pencil. Z starts 15 min after everyone else. R is absent. I assist K with play money to do his story sum. K indicates that he will buy a burger for R10 as well as 50c sweets. I ask him if he will have enough money. If you use your R10 only for your burger – will you then have enough money to buy your sweets and your cool drink? He	Homework exercise 24+10= 24-10= 39+20= 39-20= 45+30= 45-30= 56+40= 56-40= 67+30= 67-30= 89+10= 89-10= The teaching seems so disjointed without a specific plan or progression over the past few weeks. We did counting, then money, then place value, breaking up and building up. T is stretching them into bigger numbers, but they have no clear understanding of 11-20 as yet. Still not enough blocks for each learner to have their own. Exercise 19=10+_ 29=20+_ 10+_+_ 39= 30+_ 10+_+_+_ Similar sums to number 69 Also from 14 to 64 Yesterday's homework 43+30=_ 43-30=_ 51+20=_ 51-20=_ 59+10=_ 59-10=_ 66+20=_ 66-20=_ New activity 19+40=_ 19-10=_ 27+20=_ 27-10=_ 35+30=_ 35-30=_ 46+40=_ 46-40=_ 55+40=_ 55-40=_

says no. How much do you think your burger must cost. He says R5. I give him play money. He takes a R5 for the burger and 50c for the sweets. How much do you need for your cool drink? He takes a R2. We count it up together. I help him to first count the rand and then the cents. I ask him is R7, 50 is more than R10 or less than R10. He says more. I ask him if he has a R10 and has to pay R7, 50 if he will have enough money. He answers yes. I assist him in writing down the number sentence. I ask the learners what will be the most expensive, the burger or the cool drink? Chorus: the burger. I give K R10 and ask him to pay me R7, 50. I am the shopkeeper. I ask him if I can keep all his money or should I give him change. He asks for change. We count on to R10 from R7, 50. He works out that he must get R2, 50 changes. Did you have enough money? I now assist A with his sum. He has a burger for R5, 50c for sweets and R4 for cool drink. He uses play money to work out his answer. I assist by helping him to first count his rand together and then the cents. I give him R10 – pay me R9, 50. He pays me with a R5. That's not enough money. He gives me all his money. He thinks that he must not get change. I assist M with her sum. She uses play money to work out her sum. R2 burger+ 50c sweets + R3 – she works out her answer using play money. Time is up – Z has not finished his work. **Tuesday 4 August 2009** Class on mat: 08:15 T revises yesterday's word sum. Three learners share their numbers and calculations: R5+50c+ R2 = R7, 50 R3,50+50c+ R4 = R8 R8 + 50c + R5 = R13, 50 – learner used too much money. Teacher asks whether she would have been able to pay for the things that she had bought. Class chorus: no. Table activity T writes the following activity on the board. Number names 61 sixty one 66 62 67 63 68 64 69 65 70 seventy T says that the learners are now supposed to be able to write the number names to nine unaided, but that they can look it up in their books if needed. Learners must first do the story sum and then do the number names. 8:42 – toilet break	61+30=_ 61-30=_ 2, 12, 22, ...92 Yesterday's homework The learners repeat the new activity of yesterday as homework????? Books are seldom marked.

The teacher is called to the office and I am left to supervise the class. I watched and walked between the learners while they were walking. R is back at school today, but is still not looking well. He spends the whole period copying from K. K is very co-operative and happy today. I gave him a hug when I walked in this morning. He is the first learner to complete all his work and did it all without assistance. K blossoms when you praise him. I placed the play money on the table and K uses it to explain to R. L concentration is all over the place, but his completes his work correctly. M and A is also able to do their sums correctly. Z is again presenting work avoidance tactics. He does not have a pencil. When given one, he spends a long time sharpening it or staring into space. He plays with the play money and interferes with the others in the group. K could spell all the number names to nine except three. NO TEACHING OF GROUPS TODAY. TEACHER OUT FOR THE WHOLE LESSON. **Monday 17 August 2009** Four extra learners join the class as another teacher is absent. T has been teaching the concept of +10,+20 and +30 since 14/08. She has put up the number line to 100 Whole class on the mat: 08:30 They count in 4's as a class, using their fingers to count on. M is trying hard and coping, K is bored and not interested at all. T asks: How many groups of 4 in 12: Chorus 3 How many groups of 4 in 20: Chorus 5. She packs out the groups of 4 unifix blocks as the learners are counting in front of her on the mat. The learner count in 10's from 1 while looking at the 100 chart. They then count in 10's from number 3. T asks group 2 and 3 to count. A can do it. T repeats the sums of 14 August orally. L can do 45+30=75; 45-30=15 Toilet break: 8:45 Group 3 Table activity Z is absent. Learners do corrections of 14/8 work. K had all correct. Toilet break Table activity Group 1 and 2 do place value exercises: 34=10+_+_+_+4 Group 3 Mat: 9:08 Learners are called on to the mat with their number charts. Each learner is given 10 unifix cubes. T instructs them to make them into a group of 10. Put yours and your partners together. How many do you have now? T shows the 20 flard card. How many groups of 10 in 20? T points out the 2 in 20 represents 2 groups of 10. T gives each pair one	Homework exercise Analogue Digital 1 am _h00 1 pm _h00 4 am 4 pm 9 am 9 pm 5 am 5 pm 11 am 11 pm 12 am 12 pm A lot of rote memorising of methods to work out answers seem to be taught. How much understanding do the weaker learners have? Stronger learners seem to be coping well.

more block. How many do you have now? Chorus: 21 How do you write it? Chorus: a 2 and a 1 (Here I wanted to have a fit – have spoken to the teacher about this – but leave her to continue, hoping she will rectify). What does the 2 stand for? Chorus: 20. T gives each pair another group of 10. What do you have now? She repeats the previous scenario. How many groups of 10 and how many units? We can break 31 up into 10+10+10+1 (chorus with the teacher). Let's break up 21- 10+10+1 (chorus). Show me 11 blocks. Let's break up 11 – 10+ 1 (chorus). R is not interested at all. T repeats with 13 blocks	I am surprised at how well they remembered from yesterday
Group 3 at table: 9:30 I eventually gave each learner a set of flard cards at the table. L, K, M, R managed the exercise while using the cards and picked up the pattern quickly. A has no idea of the how many of a number. He struggles with the concept of 40=4tens. Why is group 3 doing the same work as the rest of the class? What about differentiation? R seems a very unsure learner – How much is his work and how much is copied? Maths lesson over at 10:00. Group 3 did the exercise for today and the one reserved for tomorrow. I undertake to make individual cards for group 3 to do as I did not know the second exercise was actually reserved for the next day.	A little bit haphazard and unplanned – neither of us have had much experience in teaching in the lab. Should be better planned – was it a waste of time? On Mondays in general the learners seem to take longer to settle in. Lots of emotional baggage from the weekend.
Tuesday 18 August 2009 T calls the whole class to the mat at 8:20 and discusses yesterday's homework. She calls upon individual learners to provide answers using the 100 chart for reference. She asks the learners whether they are going to count on or back. The learners know adding is counting on and subtracting is counting back. She explains to the learners that they are not just jumping one block, but 10 blocks at a time. This is very confusing to the learners as they are jumping 10 blocks horizontally, but one block vertically. The concept of counting in tens is not yet there? Toilet break: 8:35 Table activity: 8:45 Learners mark their homework sums and do corrections – copying from the board. A is totally not coping and the teacher moves him to group 4 – her weakest group. The teacher writes the new activity on the board. T instructs the learner to use their fingers as groups of 10 and to check on the 100 chart. L says 40+40=80+6=86. The others count on and back in tens. K copes well, R is lost. Z is back at school today, but is all over the place. Group 3 mat: 9:00	T draws the following activity on the board. 1 Ф =½ 2 O |O =1 3 OФO = 1½ She writes down the number to 10 K incidents: • Plays with pencil – told to take it

The learners can calculate in tens only by using the 100 chart. They have no mental concept yet. Not yet able to visualise. They haven't had enough concrete experience. I show them how to connect to the concrete while T is busy with another learner at the table. We use the 100 chart and the concrete together to help the learners to transfer from the concrete to the abstract. T discusses all the sums with the learners Table activity for 40 minutes The learners do the new activity that is on the board. R falls back to concrete. Z only completes three of the sums. L, K and M seem to understand it. M uses a 100 chart to work out her answers. L and K do it mentally. They do place value cards that I made for them while the rest of the class do activity 2 of place value of the previous day. They seem to have a good understanding of place value. T informs me that the next step is for her to now do completion of the ten?????? e.g. 9+7=10+6=16 **Wednesday 19 August 2009** Both K and R are absent today. Whole class on mat: 08:30 T discusses the previous day's activity that she also had them do as homework. The class answers in chorus. She asks M to do the last sum: 61+30 and 61-30. M is a little insecure, but manages to work out the answers. The learners count in two's to 92. I speak to the teacher regarding the purpose of counting: cardinal value and number patterns to assist with calculations. The teacher continues and teaches place value to the whole class. She demonstrates using flard cards. The learners do not get the opportunity to handle the flard cards at all. The teacher builds the number 11 with the flard cards. The 1 stands for a 10 and the 1 stands for a unit. She calls a learner to hold 10 unifix and another to hold 1 unifix. One stands for one group of ten or one ten. She gives another learner ten more unifix. How many blocks do we have now? The learners chorus: 21. How do we write 21? Chorus: a 2 and a 1. What does the 2 stand for? The teacher continues with this and also does 31 and 41. The teacher does the same with 12 to 42. She links the flard cards to the concrete, but only a few learners actually hold – materials are used to demonstrate rather than for learners to work with. T informs me that she intends to go on to time and shape for the rest of the week. There is so much chopping and changing – for assessment purposes?	back to his desk – throws the pencil. • Punches another boy on the mat who irritated him • Punched L at the desk – L started first • Plays with money on the mat, teacher takes it away, he threatens to call the cops on teacher, he then threatens to hit the windows in – teacher sends him to his desk. • T continues with revision – K puts his case on his back Apparently his behaviour is always very bad on a Monday and is also worse when I am there. Learners know counting on is add and counting back is subtract. A lot of them are still doing all count though. Teacher uses a lot of repetition and chorus work/rote teaching. Teacher does not use a lot of word sums.

Toilet break: Table activity The learners do similar sums to the previous day. They use their 100 charts to work out the answers. I assist group 3 with concrete apparatus. They are struggling. **Monday 31 August 2009** Consolidation of the concept time- introduced last week Whole class on mat: 8:30 T: If I say it is 9am is it in the morning or evening? T demonstrates on a clock. This is 12 o' clock midnight. Now it is one o' clock. How old is the day? Chorus: one hour. Now it is 2 am , how old is the day? Chorus: two hours. Now it is three o'clock- we are still sleeping- how old is the day? Chorus: three hours. Now it is 5 am – Muslims are getting up to pray – how old is the day? – T continues in this manner, every time counting how old the day is. It is now 1pm – how old is the day? Chorus: 13 hours. T continues in this manner. How many hours do we have in the day? T asks individual learner – 24 hours. How many days make up 24 hours? Chorus: 1 day. Learners count the days from nine to ten o'clock. How many minutes in an hour. Z answers 24 minutes and then says 30 minutes. The other learners say 60 minutes. They count again. T is called to come to the office. I explain the difference between analogue and digital time. Toilet break: 09:30 Monitors hand out books – worksheets have not been cut smaller. I move around the classroom cutting worksheets – no guilliotine. The worksheet requires that the learner change analogue time into digital time. I teach group one on the mat. T asked if I could please teach the half hour while she is at the office. I let individual learner use the teacher's clock to demonstrate the half hours. They understand quickly. I then call group 2 to the mat to teach them the half hour, but find that they have no idea of pm time. The teacher reappears for a short while, but has to leave the classroom again. Group 3 I take the big clock to my focus group and discover that they are not able to do their activity as they have no clear idea of am and pm time difference on a digital clock. M is absent, Z is like a Jack in the box, K sulks, but eventually completes his work.	35+30 45-20 56+40 52-30 22+20 88-40 77+10 92-20 Assessment rating 1 Not achieved 2 Partial achievement 3 Satisfactory 4 Outstanding I asked the teacher for her planning file so that I can photocopy her lesson plans. I photocopied her timetable and discovered that her planning ranged from 20/7 – 31/8, 3/8 – 14/8, and one roughly written page

Tuesday, 1 September 2009 Learners on the mat: 08:30 The learners are sitting at their tables and the teacher is revising their homework exercise. She asks: Is am morning or evening? Learners chorus: morning. What is one o' clock in the morning in digital time? Chorus: 1h00. Is pm morning or evening? Chorus: evening. What is 1pm in digital time? How do we work it out? Chorus: I keep the 12 hours of the morning in my head and count on one. 12,13. 13h00. T continues in this manner. All the learners now have an understanding of how to write pm in digital time. The teacher has to go and sit in on an IQMS lesson and I look after the class for half an hour. Toilet break 8:55 The teacher asks me to revise half past with the learner. M is still absent. The teacher taught analogue/digital time and reading the hour and half hour with the class on Thursday and Friday. She asks me to write six sums on the board – similar to the homework sums. The teacher asks me to call out the groups and teach them how to read the half and hour on a clock. I call out the groups and give each individual learner the opportunity to show half past a number on the clock. They discover that the short hand comes to rest between two numbers – it is past the one number but not yet the hour of the next.	The learners in general have very short attention spans and get tired after just 10 to 15 minutes on the mat. I have discussed this with the teacher and have suggested that she keep the mat consolidation in the morning as short as possible – also to give them more opportunity to practise at the tables while she does group work.
Focus group table activity I assist the focus group with the demonstration clock to work out the answers of the analogue digital activity. The teacher returns and has to leave the classroom again. Some teachers are absent and she has to check on their classes. I add extra work on the board and let the learners write number names in their homework practice book until she arrives. I supervise/teach the class till 10h00.	The focus group did not have an idea as to why they were breaking the number up into tens and units or what they were actually doing – they are just following the method.
Wednesday, 2 September 2009 Consolidation/Mental Maths I arrive late (interview with a parent) and find the teacher asking individual learners to change analogue time into digital time. Put 12 in your head and count on. M is still absent. Group 4 (her weakest group) is hopelessly lost. R and L also still do not understand.	
New lesson: half an hour – teacher uses demonstration clock It is now 30 minutes past eight o' clock. How many minutes in an hour? Chorus: 60 minutes. T: Did the hand move right around? Chorus: No, it stopped by six. T: Half of 12 is? Chorus: 6? T: Is it now an hour or half an hour? Remember it was eight o' clock, the hand has moved past the eight. Chorus: half past eight. The hand now moves another hour	I ask the teacher whether the learner have done this kind of thing before - she answers yes, but the learners look blank. Quick teaching for assessment purposes?

– to nine o' clock. The next half hour will be ... Chorus: half past nine. T: next half an hour. Chorus: ten o' clock. Is half past nine earlier of later than ten o' clock? Chorus: earlier. She asks A and L. A gets it wrong, but L gets it right. T asks individual learner. R and Z can do it. Toilet break 09:30 Time for computers Learners go to the Khanya lab where they are allowed to play on Robo Maths. They do sums in the number range (0-10). **Monday, 7 September 2009** Whole class on the mat: 08:15 On Thursday and Friday the teacher taught position in relation to a three dimensional object. She drew pictures on the board with the positional words: left, right, in front, behind, between, middle. The learners completed an assessment on this work on Friday. The teacher gave them a picture of a learner carrying books and they had to fill in the positional language in the correct places. The words could be used in more than one place and the learners had to reason. This morning the teacher revises position with learners who were absent such as M.	1 Not achieved 2 Partial achievement 3 Satisfactory achievement 4 Outstanding achievement What is more important – the method or the answers? I know it is important to expose learners to a number of methods, but isn't it more important for the learner to be allowed to discover which method works for him instead of forcing all to do the same??????? Problem solving should be the focus – not method teaching????
Refresh: Halving 08:45 T is revising the concept of halving taught at the end of the previous term for assessment tomorrow. The learners are restless. There have been three interruptions from outside between 08:15 and 08:50. T asks halving (0-10) as mental maths. Learners use their fingers to work out – putting fingers of the two hands together starting at the pinkie. At 08:55 a late comer arrives. T has to struggle to get their attention back. T informs me that M has anaemia and is often absent. M looks tired and listless. Wonder what is happening at home? Is she on medication? Toilet break: 09:00 Table activity: Group 3 All of group 3 is able to complete this activity and understand it with the exception of A. He still struggles to half uneven numbers. Another interruption at 09:50. T leaves the classroom to go and photocopy the assessment. Whole class on mat: 09:50 The learner are doing a counting and place value assessment	T initially indicated that she wanted me to watch the class as she had to go to the computer room to complete her mark schedules. I reminded her that this was my last week of research negotiated that I would help her after school. A lot of the learners come without pencils every day and have to borrow as they have lost yesterday's pencil.

tomorrow. T uses flard cards to demonstrate. T: 73 is a 3 and a_. Chorus: 7. T: How many tens in 70? She counts out 70 in concrete material. Chorus counts: 7. T shows the 70 to reaffirm that there are 7 tens in 70. T shows 44. T: How many units in 44? Chorus: 4. T: 44 is 4+_. Chorus: 40. T: How many tens in 40? K is disruptive. T has reprimanded him three times. She takes that money that he is playing with. See behaviour in right hand column. T continues with revision. She has now lost the attention of most of the class. A boy breaks a wind in class. Teaching is interrupted again. Maths time is over. 10:10. **Tuesday, 8 September 2009** Whole class on mat: 08:20 T: Remember we said that we will use our fingers to count in groups of 10. Each finger is a group of 10. 34+20. Keep 34 in your head. How many groups of 10 in 20? Chorus: 2. T: Count on. The teacher and the class count on together: 34, 44, 54. T: K, how do we write 54? K: a 5 and a 4. (T shows 54 on the flard cards) T: What does the 5 stand for? K: 5 tens. T: and the 4? K: 4 units. T asks the class: How many tens in 40? The learners count it out on their fingers. T asks again. Chorus : 4. T: Keep 54 in your head, add 40, keep the answer – I will ask. She asks individual learners. They all answer 94. T: How do we write 94? R: a 9 and a 4. T asks R: What does the 9 stand for? R looks blank. T instructs L to help him. L answers: 9 tens. T: What is 9 tens together? R and L: 90. K answers 98. T tells him that we have no units. The rest of the class looks blank. One learner answers 90. Teacher now asks mental maths/ rote. 1 group of 10 – how many fingers? Chorus: 1 2 groups of 10 – how many fingers? Chorus: 2 Teacher continues in this manner also giving individual learners the opportunity to answer. T gives one learner 4 bundles of 10 sticks to help her. It is the first time that I see her give a learner concrete materials to work with – a learner who didn't understand. She wants them to move beyond using the 100 chart to rather count in tens on their fingers or visualize the answer to sums such as 45 +20. The teacher asked me if I thought that it was good to move on to visualising. I talked to her about Piaget and that most of the learners in her class still needed concrete input, but that we must also encourage them to move to semi-concrete and	

abstract T: 55+20. L what did you do? What number did you keep in your head? L: 55. T: Are you going to count on or back? L: on. L counts on 20 and says the answer is 75. T continues to ask similar sums from individual learners. Toilet break: 08:45 T writes six sums for them to do while she goes to photocopy their assessments. As usual, a number of learners do not have pencils, etc. This is a daily occurrence. The learners are not allowed to use their number charts to work out the answers and must count in tens on their fingers. T arrives back at 9:05 and has to prepare an outing letter. She adds the following to the board: 6, 16, 26, _, _, _ 98, 86, 78, _, _, _ 81, 71, 61, _, _, _ T leaves at 09:15 to photocopy again. Group 3 at the table: Z is able to do the sums without the 100 chart. I help R with concrete apparatus to count in tens to solve the problems. K and L use their 100 charts and refuse to put them away – they are not ready and is dependant on that method – they solve their sums quickly and efficiently and then haul out paper to draw on – both love to draw. I also have to help M. She has missed out while being absent. The learners in the class have now mostly finished their work. I practice counting in tens with them from any number until the teacher comes back. Whole class on mat: 09:25 T calls them to explain the assessment task to them. The learners go to their desks and complete the task. The whole class reads the instruction – then complete the questions – then read the next instruction together out loud. K initially refused to start and could not find his pencil. I gave him mine and told him it was my lucky pencil and that he should take care of it. I asked the teacher if she would allow me to mark the class' assessments. The assessment (Task 2) consisted of: Fill in the missing numbers: Counting in tens Count the blocks (in groups of ten) write the number and fill in how many tens in that number A picture representation of 13, 12 and 15 with 11 as and example. Learners had to complete:	

_ten_ones _ (the answer or number represented) Place Value: example: 79=70+9 85=_+_ Calculations: 34+20 =_ Rating and Difficulties of Focus group A- 1 – Not achieved He experienced difficulty with everything. Z- 4 – Outstanding He struggled with the picture representations of the blocks of ten K- 4 – Outstanding He struggled with the picture representations of the blocks of ten M- 2 - Difficulty with counting in tens and the calculations L- 1 – very surprising – always seems to know what is happening when asked mentally. Difficulty with place value and calculations. Could not do it without the 100 chart. R- 1 – Difficulty with everything – I suspect that he does surreptitious copying during table activities. **Wednesday 9 September 2009** Consolidation/revision before assessment – learner on the mat. 08:20 T: I have three pencils. I share it between two friends. How many does each friend get? T draws three pencils on the board. She draws two faces under the pencils. T then "shares" the pencil drawing out and draws one pencil and writes ½ next to it under each respective face. The learners count in two's starting at number 1. T draws the halving of 5 on the board. OOΦOO T draws to faces and shares the pencils by drawing lines from the pencils to the faces. Each person gets 2½ pencils. She gives individual learner the chance to draw similar solutions to sums on the board. They have to use her method. T then asks halving in the number range 1-10 mentally. When the learners struggle, she reminds them how to work it out on their fingers. To halve six, they touch the fingers of two hands together starting from the small finger. She then moves on to halving in the number range (0-20). L, R and Z get the opportunity to solve sums individually on the board. They use the method taught to them by the teacher and do it correctly.	

11
10+1
5+½=5½
08:30 The class is now very restless.
Toilet break
The teacher writes the following class exercise on the board and asks me to keep an eye while she leaves the room to go and photocopy their assessment task.

13 14
/ \ / \
10+3
_+_=_

The learners must do the above to number 19.

Arrange from big to small (T chorus reads the instructions with the learners)
13 31 24 42 63 36
82 28 16 61 37 73
T instructs the learners to underline the ten in each number and to only look at the tens when doing the exercise.
Arrange from small to big
14 41 39 93 51 15
24 42 29 92 34 43

09:10 Teacher is back and stops them where they are – time for assessment
T. hands out assessment and is called out of the classroom to the office – I supervise the two assessment tasks and offer to mark them so that I can have a first hand idea of how the learners are doing.

Task 3 Activity 1

Z – 2 – Struggles with arranging from big to small, small to big as well as halving
M – 3 – Struggles with arranging from big to small , small to big
R-1- Struggles with everything – Can draw the halving out, but not write it – only marks for written answers.
K-1-Can halve, but does not understand the method. Also struggles with arranging the numbers
A-1-does not have a clue.
L-3- Struggles with arranging the numbers

Task 3 Activity 2
L-3- Struggles with some of the number patterns and subtraction e.g. 45-3

K- 4 A-1- NO idea of number patterns or calculations R – 1 – Poor number patterns and calculations M-2- Number patterns Z-4 Z struggles in class, but does well in assessments- he has fine motor control difficulties **Monday 14 September 2009** 08:40 – late start on the mat as a parent came to visit. I have now met quite a number of the parents of the weaker learners and have managed to assist the teacher during the interviews with these learner's parents. T is consolidating halving. She reminds the learner about when they did halving on a concrete level. She again demonstrates with her fingers and the learners copy. She asks individual learner of the two weaker groups in her classroom to halve uneven numbers to 10. They can do it on their fingers. Groups 1 and 2 will do semi-concrete halving 11-20 today. Group 3 and 4 will do halving – 10 concrete and semi-concrete. The teacher and I discuss that the learner need more concrete and semi-concrete to half from 11-20 while breaking up the numbers. They also need to understand why they are breaking up the bigger number in tens and units when they are halving. T decides to keep them all on the mat and teach them from 11-20. I notice that she has lost the concentration of her weaker learners and suggest that she send group 3 and 4 to the table to do her activity and teach group 1 and 2 on the mat. She can then swop over. Table activity for Group 3 and 4 The learners copy the following from an activity sheet into their books. 1 Φ ½ 2OO 1 Etc to 10 They then turn the paper over and do the activity on the back, halving first even numbers and then uneven numbers to 10. My focus group – with the exception of A – complete these exercises quickly and correctly. As usual there was the daily scramble for pencils. K refuses to work. I ignore him and give attention to the others. He starts to work. I assist A today. He and another learner have no idea about the concept of sharing – never mind halving. Both of them need lots more concrete sharing out of objects. I would say this is true for the whole of group 4. I take group 3 on the mat – not A – to teach them halving from 11-20 with the breaking up of numbers. I link concrete sharing to the semi-concrete	

in the board, allowing the learners to discover why we break the number up into tens and units and then halve it. The learners go back to the tables and followed the teacher's example on the board. 11 OOOOO|OOOOO 5 Ф ½ 11→5+½=5½ L, K and R complete the exercises correctly in their books. M and Z and are still busy with the first exercises. Maths time is over. **Tuesday 15 September 2009** The circuit team is visiting the school today for pre-progression and promotion discussion. There are many interruptions and requests from teachers and we can only start the lesson at 08:30 today Mental Maths The teacher revises halving 0-10 with the whole class. She then goes on to the halving of numbers 11-20. The apples are getting more and more and more. Instead of sticks, we now draw apples. 11 apples – we separate the tens from the units – 10 in one row- 1 in another row. She puts the same example as on Monday on the board. The teacher revises yesterdays activity completed by group 1, 2 and some of the group3 learner. K has been acting out all morning. The learners only did halving to 14 yesterday and the teacher now instructs the learners to do halving in their books from 15 to 20. The teacher and I are called to the office to meet with the circuit team. The class is supervised by a parent. The teacher discusses with other teachers in the staff room how important it is to go back and do concrete, semi-concrete and abstract for each concept taught. **Wednesday 16 September 2009** I go to the classroom – the teacher is not teaching maths today and requests that she needs to catch up on literacy. I think that this will be my last session. I have thoroughly enjoyed the experience. When you withdraw small groups of learners from the classroom for intervention purposes you lose touch with the bigger picture and the daily struggle of the teachers. Factors such as resources, number of learner, discipline, social and emotional issues and interruptions have a far bigger impact on teaching than one realises. I think that I have learnt more from her than she has from me.	

Issues of difficulty How to be diplomatic – keep the relationship going – I think that I have succeeded. Not being able to be in the classroom the whole week. The time is so short – six months would have been better. Classroom intervention can be more effective than the withdrawal of learner for remedial purposes How do I write negative issues in my thesis without offending the teacher or putting her on a spot????	

APPENDIX D

Journal 2: Action research cycle January – March 2010

Monday 25 January 2010	
This is my first visit of the second action research cycle to the grade 2 English class in a school in Manenberg. Schools opened on Wednesday 13 January and the teacher asked me to give her some time to get to know her new learners before I come to conduct research. The teacher and I spoke about the focus of the research. I informed her that although some of the learners of my previous focus group are spending another year in the same grade, that I would be focus more on how number sense is develop during in teaching practice in the classroom. There are 46 learners in the classroom and the initial feeling is that of being totally overwhelmed. Due to the small size of the classroom and the big number of learners, quite a number of learners have to sit with their back to the board. This further complicates teaching as the teacher uses her blackboard a lot and the maths exercises are written on the board. Some of the weak learners, who are already struggling to write in lines, have to look over their shoulders or turn around to copy the maths exercise off the board. This complicates things even more. They spend a lot of time copying and less time practising maths. As usual the teacher starts with rote counting with the whole class on the mat. She has a number chart (0-100). There are counters marking every second number, indicating how to count in two's to 50. One learner points with a stick and the class counts in two's by rote, looking at the number chart. They then have to count backwards in two's from 50 following the same procedure. There is an exercise of bonds of 5 and 6 written on the board. The teacher asks the learners the answers to the sums. The learners have now spent about 15 minutes on the mat. They are starting to become quite fidgety. The maths lesson started late as some of the maths time has been taken by assembly. The teacher blames the learners's inattention on the long assembly. The whole class then do the bonds of 5 and 6 exercise that has	

been written on the board. The teacher calls group 2 to the mat and does some counting exercises with them. Individual learners get an opportunity to count out 30 counters. The teacher gives them a variety of objects, including an abacus, to count with. Not all the learners in the group have their own concrete material. The teacher feels that only every second learner should have as the others then don't concentrate and play with the equipment. I ask the learners what is the fastest way to count out 30 objects. They respond – in tens. When I ask the learners why to we count I am met with blank looks. It seems that counting to them is just counting by rote or practising counting. We then talked about various things that we count and why. Group 1 completes the exercises quite quickly and then sit around doing nothing. Still not enough activities I suggest to the teacher that she must always inform the learners as to the purpose of an exercise. I propose that each learner should have their own concrete equipment on the mat and that concepts should be taught from the concrete to the semi-concrete to the abstract. I also recommended that the learners in group 4 and 5 be allowed to have the concrete equipment on their tables as they so obviously still needed to work out the bonds by counting concrete equipment. **Tuesday, 26 January 2010** There is no maths lesson today as all the learners have been called out to the field to practise athletics. The teacher will do maths later in the day. I am not able to attend. **Wednesday, 27 January 2010** The whole class is on the mat again and again practise to count in two's to 50 and back. The teacher then discusses the previous day's work that is on the board. Individual learners get the opportunity to answer and the teacher writes the correct answers on the board. The learners go to the tables to mark their own work and copy the correct answers from the board. They spent about half an hour on the mat. They do exercises of bonds of 9 and 10 today. I take Group 3 and 4 to my class to do intervention in bonds of 5. The classroom is just too small to accommodate both teachers working with groups. We use counters and I allow	

the learners to discover various ways of making five. It is obvious that they have had a good grounding in manipulating concrete equipment and that they can then with a little assistance make their own number sentences about five. They are however, not able to recall the bonds of five mentally. I source colour shape cards from the grade 1 teacher to allow the learners from group 3 and 4 to have semi concrete assistance when working with the bonds of 5. I take the learners back to the classroom and advise the teacher to only work to five with these groups. I explain to her how to use the colour shape cards. **Monday, 1 February 2010** The learners have reading half hour from 08:00 – 08:30. They then have assembly till 9:30. This leaves us with half an hour for mathematics. The learners all go to the mat to count forwards and backwards in two's to fifty while one learner points on the number chart. The learners are called to go to athletics practice. I request to meet with the teacher during second break and she agrees. **Meeting:** The teacher and I discussed classroom organisation strategies during this meeting. We negotiated that she would reorganise her Monday timetable to allow for an hour's Maths period after assembly. I proposed that the learners be given work cards and when they have completed one, they go and fetch another and so forth until ten minutes before the end of the lesson. At this time they then do not fetch new work cards, but just complete what they are busy with. The teacher voiced the following objections regarding this. She felt that the learners still struggle with the setting out of their work. The teacher also felt that there would be too much movement in an already crowded classroom. She further voiced her concern that with such a big class, marking would become a monumental task. We came to an agreement that the learners be given extension tasks and extra exercises in booklet form that they would be able to complete independently after completion of the daily task on the board. The teacher also agreed not to spend so much time to getting the learners to mark their own work. While there is value in this, it is also very time consuming. The teacher and I worked out the following structure for her on	

the mat. Mental Maths: 10 minutes Rote counting: 5 minutes The learners will then go to their tables to commence with their exercises. The teacher can then call out two groups in time periods of 15 to twenty minutes to alternatively do story sums and/ or numerosity. The teacher is going to try to get a blank A 4 mat book for each learner to work keep evidence of the working out of story sums. This leaves the teacher with time to consolidate the concepts again at the end of the maths lesson. **Tuesday 2 February 2010** Whole class on mat: 08:30 Mental Maths: Teacher asks bonds of seven Rote counting: Learners count on in two's -50, count on and back in ones -50, Concept of what comes before and after a specific number. Toilet break: 08:50 Activity and group work time: 09:00 09:05 – The athletes are called out and the teacher has to adjust her lesson as a lot of learners have to leave. Activity: On the board: Fill in the missing number – counting back from 50 – Group 3 and 4 are allowed to use their number charts as reference. Group 1 extension- They do activities in a pre-prepared activity book. Group 3 and 4 are called on the mat. The teacher does the concept of before and after. They struggle with the words before and after and the concept thereof. We line them up in a row to to explain. They do story sums on blackboards (mat books still coming). There are 7 fish- two jumped out and 1 died – How many are left in the bowl? The learners draw out the sums and all seem to be able to work out the answer to the problem. The	

teacher asks some of the learners to explain their methods. The teacher repeat the same pattern of story sums with group 2, but uses the number 11. The learners solve the problem by drawing pictures. The teacher guides them to write a number sentence. The athletes come back in the middle of this and our maths time is over. **Wednesday 3 February 2010** 08:40-09:00 Mat: Mental Maths: Teacher gives individual learners chance to answer sums about number 6. Learners count in 1's -50 and back, 2's-50 and back. Written activity on board: Before and After to 20 Group 1: Teacher gives the learners 11 counters and allows them to make their own sums of 11 on a black board. Group 2 : They do the same as above - they are no ready and need to go back to bonds of 8/9. Group 3 and 4: Second activity at the tables: Copy the number names from 1-10. **Monday, 8 February 2010** I am now concentrating purely on how the teacher teaches and not on how my focus group – who have moved on- learns. This gives me a totally different perspective. Today, I made a video of the teacher's lesson. She was very stressed and perturbed by the fact that I was purely observing and not interacting with the learners. Classroom organisation has improved markedly with better utilisation of the teaching time. Group 1 and 2 were quietly busy during the whole lesson. Group 3 and 4 were restless, but it was more due to the developmental immaturity of the learners and their short attention spans than a lack of activities. Group 3 and 4 – the intervention learners make up 16 of the 46 learners in the class. This is a rather big percentage. This has an emotionally detrimental effect on the teacher as she is losing hope in her struggle with this big class with so many systemic interruptions and extra duties heaped upon her as the	

HOD. Classroom organisation is now fixed. The next problem is the relevance of the written activities to the concepts that are being taught. I have checked the maths work schedule and have found that the teacher is again teaching in a haphazard fashion. Will have to sit her down and work on her planning and explain what goes where and when. I worked out a mathematics teaching plan for the next two weeks according to the work schedule supplied by the department of education. I gave it to the teacher as an example and we discussed how it was possible to incorporate all that was expected. The work schedule is quite detailed and includes a lot of different types of activities on a wide range of concepts to be covered during a two week period. There is good progression in the structure of the teaching plan, but time constraints might impact on the total and thorough completion of the teaching plan. The teacher utilised part of the teaching plan. I was unfortunately not able to observe as my son was in hospital during this time period. **Monday 1 March** Class discussion: The concept of big and small. The teacher informed me that she was just consolidating this concept as she had completed quite a lot of work on the concept of size during the previous week. It was soon clear that while the learners had a good understanding about the concept of size, the weaker learners still struggled to transfer the knowledge of size to big and small numbers as well as the sequencing of numbers from big to small. The teacher gave individual learners number cards of different sizes and the class helped to arrange the learners with the numbers from the big number to the small number. The class then counted in groups of ten and discussed how to write down five groups of ten as a multiplication sum. Mat: The teacher worked with group 1 and then group 2 on the mat. They were given word sums with groups of ten in their activity books on the mat. Some learners drew out the whole sum and others very quickly wrote the solution as a multiplication sum. The teacher encouraged them to do it in as quickly a manner as possible and the learners shared the solutions of their problems with one another.	

Table activities: The learners at the tables did an activity that was written on the board. They had to arrange numbers from big to small. I assisted some of the weak learners individually and discovered that sometimes the numbers were just too big for them and they had no yet formed a concept of that specific number and where it belonged on the number line. The teacher told them to use their 100 chart to assist them, but then the whole task just became to complicated to handle. I discovered that the weaker learners respond better when you allow them to work with numbers in their field of understanding and give them a strategy on how to attack the activity. All learners worked in their activity books after completion of the task on the board. This has lessened the noise level of the learners in the classroom as they are all constructively engaged. The level of the activity book is very suitable for the weaker learners in the class and it provides good opportunity for the consolidation of addition and subtraction skills of Grade 1. I would like to see that the teacher also differentiate in the level of activities given to the learners. **Tuesday 2 March** Classwork: The teacher revises the concept of big and small and the learners give the answers to yesterday's exercise on the board. She then revises before and after. She uses three learners to demonstrate the concept of before and after. The learners count in tens from any number on and back to 100. The teacher informs me that this is only her third year teaching grade 2 learners. She is senior primary trained and is currently enrolled to do her ACE in Foundation Phase. The teacher send them to the tables to complete a before and after exercise. I again assist some of the learners at the tables. She calls group 3 and 4 to the mat and does estimation with them. The teacher puts out a group of counters and the learners must estimate how many there are. She covers it with a cloth and then asks them to guess. They make the counters into groups of ten and then count them to see who was the closest to the correct answer. They do word problems in their activity books with groups of ten just like the groups from the day before. My son is admitted to hospital and I lose out on my research again. **Tuesday 23 March**	

I am feeling a bit dubious about going to the grade 2 class today as it has just been a long weekend and is the last week of the term. This is however, the last opportunity that I have left to conduct research. I arrive at the class to find the teacher not there. The learners are sitting on the mat. I start to flash bonds of 5 and 6 to them to keep them occupied. The teacher is organising replacement teachers/parents for two classes where the teachers are absent today. She is also collecting money's for the surf walk outing from all the classes under her control. We quickly had out activity sheets for the learners to complete. I supervise the class while she is sorting out the moneys. Group 1 do exercises around number 15: Half of, Double, addition, subtraction, etc. Group 2 do exercises with groups of 3 and 4 – writing it in multiplication format. Some of these learners have not quite grasped the concept of multiplication and linked it with groups of. I assist where I can. Group 3 and 4 do bonds of 7. The teacher instructs me to give each learner seven sticks to help them. This is a big change. The teacher was not always previously open to the learners using concrete apparatus at the desks. They normally had to share with another learner on the mat – NOW they each get their own. The teacher is also differentiating in the difficulty levels of the activities that the learners have to complete.	

APPENDIX E

Questionnaire completed July 2009

Appendix 2

NUMBER CONCEPT DEVELOPMENT

The purpose of this questionnaire is to gather initial data about teacher practice and strategies in the development of number concept in a Grade 2 class.

Please complete the questionnaire by answering as many of the questions as you are able to. If you should choose not to share due to the sensitive nature of the information, you are allowed to leave some of the questions unanswered.

All information will be considered confidential.

1. What are your education related qualifications?

   ____

2. For how many years have your been teaching in the Foundation Phase?

   10yrs

3. For how many years have you been teaching Grade 2 learners?

   3yrs

4. How much time do you spend teaching mathematics on a weekly basis?

   7 hrs

5. How much time out of your daily mathematics lesson do you spend on number concept development?

   1 hr

6. What is your understanding of number concept development?

   ____

   ____

   ____

25

7. List the Learning and Teaching Support Material that you use in your classroom to support the development of number concept.

concrete counters; abacus; number chart; charts; worksheet.

8. List the teaching strategies that you use to develop number concept strategies in your classroom. concrete - known - unknown.

9. Which of the above teaching strategies would you consider to be the most effective? Provide reasons.

10. How do you cater for learners in your class that need intervention in the area of number concept development? How do you scaffold their learning?

group teaching
Define their learning barriers. Try to accomodate their diff. learning styles.
Use concrete & semi concrete. Consolidate

11. In what way do you reflect on your own teaching practice?

12. What strategies do you employ if you encounter problems with any aspect of your teaching? Using the known concepts move to unknown

13. With which aspects of the curriculum that deals with number concept development do you need assistance?

14. What factors hamper your teaching?

Too many learners ie. 43 learners.
10 learners have learning barriers.
More than half of the class is at level 1. They also struggle to read the instructions.

15. What do you think could be done to counter the factors mentioned in questions 14?

Reduce the learners per class.
Accomodate the high risk learners in special class/school/unit. A school readiness programme at the entrance of grade 1.

APPENDIX F

Interview conducted on 2009/09/21 at 13:30

This is an interview with the teacher of the class where action research was conducted. For the purpose of anonymity I will refer to her as Teacher. We will identify the focus group learner by making use of their initials when we speak about them.

T = Teacher

R = Researcher

R: Eh, Teacher, could you please indicate that you are aware that the interview is being recorded with your permission.

T: Yes. Miss Scholtz, I am aware of that.

R: Thank you

R: Which aspects of the classroom support did you find helpful?

T: (silence) Let me, (silence) let me just think now, the intervention the, the learners who are not at the level, that, that are at the level one, numerosity level one, level. I find your assistance extremely helpful there. (silence)

R: OK, which aspects of the classroom support did you find disruptive or less successful?

T: From your side, support from your side? Emm, (silence) No not actually it was more successful, it was just emm the attention that you were giving towards, the individual attention that you were giving to, emm (silence) I think one learner in particular, he emm, he wanted more, he wanted more of your attention and eh, he didn't much take into consideration that you were there to also assist the others.

R: Which factors pertaining to the general running of the school has an impact, has an impact upon the teaching and learning of mathematics in your classroom?

T: (Silence) Was it positive impact or negative?

R: Either or

T: (silence) Emm, (long silence) negative impact was the interruptions of learners that need, that need some things from me from other classes – and the next thing and Emm , then, (silence) I think otherwise I can't see any other negative impact except emm we probably need some more resources for the learners, we definitely need more resources for the learners.

R: Which teaching method do you find more successful when developing number sense in your weaker learner?

T: (Silence) Emm, that I would say definitely concrete, concrete objects, (silence) eh concrete objects is some, is one of, is a, is very important and then leading them to the semi-concrete. Emm (silence) what do you call it now? Emm, leading them to the semi-concrete.

R: What have you learnt new or have been refreshed or reminded about?

T: Emm, quite a few things, emm, the strategic planning, as if I not, it's not important because eh to really see my progression – how the learners progress from the emm, from the one level to the next level.

R: What background information can you share about the learners in the focus group that will help me to understand them better?

T: (silence) About me?

R: About the learner, (silence) learner K for instance, what gives rise to his emotional turmoil?

T: Ok, yes, eh, these learners come with a lot of social, social barriers and they need forever attention and eh when you give them the attention they just wouldn't want you to be shared with the others, they become a little bit selfish because emm, they need, they want your continuous attention, so we really have to still work on letting them understand that emm, you have to also give attention to the others, emm, social yes is the problems that they have economic problems that they have, emm, we try at the beginning of the day to just find out if there is anything that really emm, had a bad influence, that badly affected them and they openly will tell – so you work around that – so that you can also be informed when it comes, ok, you know how that learnerren's mood could be for the day.

R: In your opinion, what impact has the classroom support had upon the learning and teaching of mathematics of the focus group learner?

T: (Long silence) Very, very positive in fact they were very keen and they're willing because you could reach them. Emm, (silence) it was a small group so you could give them the attention that they need at all times and a you could close also the gaps in their atten..., when you see them, because you've been monitoring them on a continuous basis and they again found it very enjoyable and they've been actually showing an increase in their emm, in their emm achievement (silence) also in their motivation, the motivation played emm, a big, because of you being motivated which actually leads to them becoming self motivated, you can actually see there were times when they want to give up , but because they, they were like motivated all the time, the focus was on them, they were keen to complete tasks and trying to do their best.

R: What is now your understanding of number sense development?

T: Emm, (silence), yes I think, I think it is important that we eh, take note of the progress of the numbers development with learner and aaa also to always continue consolidate and then move on to the emm, next progression of that of that concept.

R: Are there any other comments that you would like to make regarding the research?

T: I find you, I find you very helpful, you really tried your best to assist us

R: Thank you

T: And I've been very grateful for that what you have done and I am going to miss you

(laughter)

R: Thank you

T: It really assisted me with a big class.

R: Yes it does help to have an extra person

T: Yes I need, it also emm, I was also very thrilled to see what these learners can. You know what they can achieve with just that extra support, because emm, without your support it would have been very difficult for me to get those learners to that level, because they just needed my continuous attention at all times and I couldn't give that to them right now and it's no use keeping them in at break because they need that time and when it's home time it is sometimes very difficult for us to keep them behind, because we will be responsible for any violence that happen outside the gate, then it becomes our response how that learner is going to get safe home so emm, I could see they really enjoyed that. You know you really eh let them skills they so want to like you that it even had an influence on their, on their literacy.

R: I am glad to hear that.

T: No, they're very keen because they know now that they are coming on par. Today they were well aware that they were behind the rest of the class and now they could actually, they actually realise that they could also achieve, you know and it actually, that motivation it actually rubbed off on to the, the, their reading where they realise emm, if they put just a little bit of effort in, I can also get there – so it really had positive results.

R: I'm glad. It just shows you that classroom intervention does work.

T: Yes it does.

R: Thank you very much. Thank you for your help and also for your kind words. Thank you.

APPENDIX G

Class timetable: 2009

ROOSTER / TIME-TABLE 2009

PERIODE PERIOD	TYD TIME	MAANDAG MONDAY	DINSDAG TUESDAY	WOENSDAG WEDNESDAY	DONDERDAG THURSDAY	VRYDAG FRIDAY	TYE - VRY TIME- FRI
	08H00-08H30	LIFE SKILLS					
1	08H30-09H00	NUMERACY					08H30 09H00
2	09H00-09H30						09H00 09H30
3	09H30-10H00						09H30 10H00
4	10H00 10H30	LISTENING / SPEAKING PHONICS					10H00 10H30
P O U S E / I N T E R V A L							
5	10H50 11H25	READING WRITING HANDWRITING					11H00 11H35
6	11H25 12H00						11H35 12H10
7	12H00 12H35	LIFE SKILLS					12H10 12H45
P O U S E / I N T E R V A L							
8	12H50 13H25	READING					
9	13H25 14H00						
10	14H00 14H35						

	PER WEEK	PER DAY
ASSEMBLY :	30 mins	30 mins
NUMERACY :	7 hours 30 min	1h 30 min
LITERACY :	9 hours 10 min	4 x 1h 35 min 1 x 1h 15 min
LIFE SKILLS :	5 hours 50 min	1h 10 min
READING :	2 hours 30 min	30 min
	25 hours	5 hours

APPENDIX H

Numeracy planning: July – September 2009

NUMERACY LESSON PLAN

WEEK: 21 – 22

DATE: 20·07 – 31·08

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY

Number operations. Daily counting.

ones from 1 – 200 abacus / number line / number chart.
ordinal first – thirtieth – number line.
multiples of 10, 5, 2 from any number 0 – 200
count in fours. / objects to 100 Mental calculations – 30

Number Concepts

Revise: 19 – relationship before / after / middle / bigger smaller than
Add & subt. of 1 and 2 digit numbers to 50.
Bonds to 19. Number words to sixty six.
Introduce: 20 / word twenty, cardinal value of 20.
groupings of 20. First to twentieth. Bonds.
Groupings in tens and units. 10+1 10+5. / Word sums

Patterns:

halve and double to 20. Add & subtr. 25+11 25+13.

Measurement:

Introduce ½ / ¼ / paper folding & cutting of different shapes.
Time: calculate elapsed time in hours / Identify important dates on calendar.

APPENDIX I

Numeracy planning January – March

Lesson plan - NUMERACY						
Grade: 2A	Week: 3/4	Date: 01. 02. – 12. 02. 10				
		MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
LO 1	COUNTING					
	NUMBER CONCEPTS	Revise : Numeral 10. Introduce : Numeral 11 Ordinal numbers : first to eleven.				
	CALCULATIONS	Different groupings of eleven and bonds. Storysum :				
	MONEY					
	FRACTIONS					
LO 2	PATTERNS	Create pattern with physical objects. Copy and extend simple number patterns.				
LO 3	SPACE & SHAPE	Recognise, identify names of 2D shapes and 3D objects in school environment – e.g. spheres ; prisms and cylinders.				
LO4	TIME CAPA/MASS/LEN MEASUREMENT	Recognise days of the week, months.				
LO5	DATA HANDLING					Sorting data according to physical attributes.
Assessment Formal / Informal	COUNTING: 1's ; 2's 5's & 10's from 0 – 50. MENTAL : WRITTEN					

2010

Grade: 2A	Week: 5	Date: 15 . 02 – 19 . 02 . 10				
		MONDAY	**TUESDAY**	**WEDNESDAY**	**THURSDAY**	**FRIDAY**
LO 1	**COUNTING**	in multiples of 2's from any number between 0 – 50 Count out objects to 30			Counting forwords/backwards from any number between 0 – 50	
	NUMBER CONCEPTS	Revise 11 / 7 Introduce 12 / 8 Bonds Group 1, 2	Revise 5 Introduce 6 Bonds Group 3 . 4	Ordinal Numbers 1st – 10th Group 1, 2	Group 3 . 4	
	CALCULATIONS	Flash addition and subtraction 0 – 10		Flash number names Calculate on number chart		
	MONEY				Conservation of coins 2c ; 5c and 10c .	
	FRACTIONS					
LO 2	**PATTERNS**	Number patterns →				
LO 3	**SPACE & SHAPE**					
LO4	**TIME CAPA/MASS/LEN MEASUREMENT**	Compare long / short long longer longest.		Calender: How many days / weeks in a month. Months of the year.		Time: Clock. face, hands. hours.
LO5	**DATA HANDLING**					
Assessment Formal / Informal						

15/02/10
[illegible]

Lesson plan

Grade: 2A		Week: 7		Date: 01 03 – 05 03 10	
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mental maths 10 min	What comes after 15; 25; 55; 69.	What comes before 50; 60; 70;	What is the 6th, 10th; 9th month.	What day is the 5th; 10th; 21st.	Revise.
Counting 5 mins	Counting backwards in 10's from any number between 0 – 100 →		Count in 1's from any number between 20 – 100.	Counting forwards in 5's from any number between 0 – 100.	
Group work 25 min each (x2)	Gr1 Estimation of counters. Counting of objects. Do groupings of 10 to 100 Gr2 Estimation of counters. Counting of objects. Do groupings of 10 to 70	Gr3 Estimation of counters. Counting of objects Do groupings of 10 to 40. Gr4 As for group3.	Gr ASSESSMENT TASK 2 ACTIVITY 2 Gr	Gr ACTIVITY 3 Gr	Gr Gr
LO 1 Number operations and relationships	Arrange numbers from smallest to biggest Groupings of 2	Arrange numbers from biggest to smallest. Groupings of 2.	Bonds of 13		
LO 2 Patterns			Identifies and describes number patterns created.		
LO 3 Shape and space				Identifies 3D objects in the environment. ie. drainpipe - cylinder ball - sphere; boxes - prisms.	Revise and compare 3D objects that roll or slide.
LO 4 Measurement				Measure 3D objects with eg. piece of string → length of table, books etc in handspans.	Consolidate.
LO 5 Data				Sorting out of different shapes.	Count the shapes and record them.
Assessment	Arranging numbers from smallest to biggest and biggest to smallest.		Bonds of 13	Identification of 3D objects	Recording of shapes

01/03/10

Grade: 2A	Week: 6	Date: 22.02 – 26.02.10				
		MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
LO 1	COUNTING	in multiples of 5's from any number between 0 – 50 Count out objects to 30			Count in 10's forward and back-words.	
	NUMBER CONCEPTS	Revise 11 / 7 Introduce 12 / 8	Revise 5 Introduce 6			
	CALCULATIONS	Flash addition and subtraction cards. 0 – 10		Word sums Group 1, 2	Word sums Group 3, 4	
	MONEY					
	FRACTIONS					
LO 2	PATTERNS			Complete patterns.	sequence shapes according to a pattern	
LO 3	SPACE & SHAPE	Identifies 2 D shapes Describe the properties. Group 1, 2	Group 3, 4			Cut and paste shapes.
LO4	TIME CAPA/MASS/LEN MEASUREMENT	Compare big / small big bigger – biggest.				
LO5	DATA HANDLING			Sort data shapes and	according to their colour.	
Assessment Formal / Informal						

Lesson plan

Grade: 2A		Week: 8		Date: 05.03 – 12.03.10	
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mental maths 10 min	Which is less 35 or 39 etc.	Which is more 59 or 79 etc.	Who has fewer ?	How many more has James than John etc.	Revise .
Counting 5 mins	Counting in 2's number between	from any 0 — 100	Rote counting between 30 — 100.	Counting in 5's number between	from any 0 — 100 .
Group work 25 min each (x2)	Gr 1 Story sums : A shirt has 10 buttons . How many buttons do 7/9 shirts have. Gr 2 As above — Count buttons on 5/6 shirts.	Gr 3 Count the buttons on 2/3 shirts . Gr 4 As above .	Gr 1/2 Revise doubling and do halving. Gr 3/4 As above .	Gr ASSESSMENT TASK 3 ACTIVITY 1 Gr	Gr Gr
LO 1 Number operations and relationships	Start with 25/35 counters - Take away 2 counters at a time . Discuss counter remaining . Use vocabulary odd ; even uneven .		Doubling between 1 — 10		
LO 2 Patterns			Discuss if counting starts on an even number all numbers will be even etc.		
LO 3 Shape and space				Compare 2D Shapes with straight and rounded edges .	→
LO 4 Measurement				Learners identifies their birthday months.	Time : Introduce the clock - hands, face different types of clocks .
LO 5 Data				Counting all the birthdays in each month .	Recording of the birthdays of each month on a chart .
Assessment	Number patterns .		Fill in the missing number.	Sorting of information .	Recording of data .

Lesson plan

Grade: 2A		Week: 9		Date: 15 03 – 19 03 10	
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mental maths 10 min	Number between 68 70 etc.	How many numbers are there between eg 89 – 100 etc.		Number between any two numbers.	Halving of 2 – 20
Counting 5 mins	Counting in 1's 60 –	starting from 100	Counting in 5's backwards to number.	forwards and 100. at any	Count out objects to 34
Group work 25 min each (x2)	Gr 3 Learners work in pairs. They do repeated add. of 5 to 20/25 5+5+5+5+5. Gr 4 As above Do also repeated subtraction 20-5-5-5-5	Gr Gr	Gr Gr	Gr 1 Learners work in pairs. Repeated addition and subtraction of 5 to 50 Gr 2 As above but to 40	Gr Numerosity of numbers Gr 8 – 14.
LO 1 Number operations and relationships	Revise doubling Open frame number sentences	Revise halving			
LO 2 Patterns			Discuss the number pattern in eg. 4, 9, 14, 19		
LO 3 Shape and space					
LO 4 Measurement		Estimates and measures objects using handspan, footsteps / strides			
LO 5 Data					
Assessment	Doubling	Halving	Measurement with handspans and strides.	Number patterns	

15/03 Read

Lesson plan

Grade: 2A		Week: 10		Date:	
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Mental maths 10 min	What number is one more than	What number is one less than . . .	What number comes before . . .	What number comes after . . .	
Counting 5 mins	Counting in 1s 70 – 120.	starting from	Counting in 5's 1 or 9.	starting at	Count objects to 34
Group work 25 min each (x2)	Gr 1 Addition. Word Problem to number 35. Gr 2. As above number range to 25	Gr 3 Addition Problem to 15 Gr 4. As above.	Gr 1 Subtraction Word Problem to 35 Gr 2. As above number range 25	Gr 3 Subtraction Word Problem to 15 Gr 4 As above.	Gr Gr
LO 1 Number operations and relationships	Revise ordinal numbers. Number names and symbols 11 – 19	Even and uneven numbers.			Revise number names and symbols 20 – 29.
LO 2 Patterns			Identifies the pattern 55, 57, 59/ 46 48 50	Design patterns for Easter eggs.	
LO 3 Shape and space		Use squares to investigate which numbers could be square numbers. →			
LO 4 Measurement					
LO 5 Data					
Assessment	Number names and symbols	Even and un-even numbers	Patterns		

15/03

NUMERACY LESSON PLAN

WEEK: 23|24 **DATE:** 03.08 — 14.08

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
Numbers, Operations.	10 and 2 from any number 0 — 120. 4's to 20. Objects to 100. Mental to 30. Number concepts: Revise 19, 20. Introduce 21. Ordinal number first to twenty first. Number words 71 — 75. Place values: Revise place values of numbers 10 to 19. 10+1 = 10+5. Decompose 2 digits 26 = 20+6 / 26 = 10+10+6.				
Patterns	Copy and extend number patterns.				
Space and Shapes.	Describe positional relationships between 3D objects eg. Describe from your desk the box on the table in the front of the class. Recognise 3D objects from dif. positions.				
Measurement.	Conservations of number in coins R5 = R2 + R2 + R1. Introduce word problems, Do shopping activities.				

Maths.

LO1: Back Ifern. multiples of 10, from 0–200 (5, 2. any no.)
22 – before / after. 4s to 20.
Groupings in tens & units. What makes
Give 20 block – make groups of 10.
21 = 20 + 1
10 + 10 + 1.

31

LO2: use numberline.
20 + 10 / 40 + 20 60 – 10.
extend number patters.

LO3: Recog 3D Objects from diff. positions.
Describe 1 positional relationship between
*. self and object

LO4 Time.
Revise face, hands; use of clock. Read analogue
analogue & digital clock
~~hours~~ and digital time in hours.
Duration of 1 hr. movement of hands during
1 hour. Minute hand start and end on 12.
Minutes flashing 60 times in one hour.
read hours and half hours.
Repeat 2 o'clock 14h00 15.30 half past 3.

DOWNEVILLE PRIMARY SCHOOL

GRADE 2 A | **NUMERACY** | **DATE ....**

TASK 3 | **ACTIVITY 1** | **NAME..........................**

A. Rameez has 9 sweets . He must share equally with his brother. How many does each one get?

B. Ashton has 7 lollipops. He gives half to Keenan. How many does each one get?

C. Complete the halving of the following numbers.

[redacted]

e.g.

14 =	10	+	4
Half	5	+	2
Add	7		

1

12 =	10	+	2
Half		+	
Add			

2

15 =	10	+	5
Half		+	
Add			

3

16 =	10	+	6
Half		+	
Add			

4

19 =	10	+	9
Half		+	
Add			

D. Arrange the numbers from big to small.

24 42 63 36 79 97

___ ___ ___ ___ ___ ___

56 65 67 76 43 34

___ ___ ___ ___ ___ ___

E. Arrange the numbers from small to big.

82 28 23 32 14 41

___ ___ ___ ___ ___ ___

16 13 31 21 12 39

___ ___ ___ ___ ___ ___

DOWNEVILLE PRIMARY SCHOOL

GRADE 2 A | NUMERACY | DATE ....

TASK 3 | ACTIVITY 2 | NAME..........................

A. Complete the following number patterns.

4	8	12	_____	_____	_____
20	22	32	_____	_____	_____
106	96	86	_____	_____	_____
66	76	86	_____	_____	_____
105	100	95	_____	_____	_____
75	80	85	_____	_____	_____
31	33	35	_____	_____	_____
61	63	65	_____	_____	_____

B. Calculate

63 + 5 = _____

73 + 5 = _____

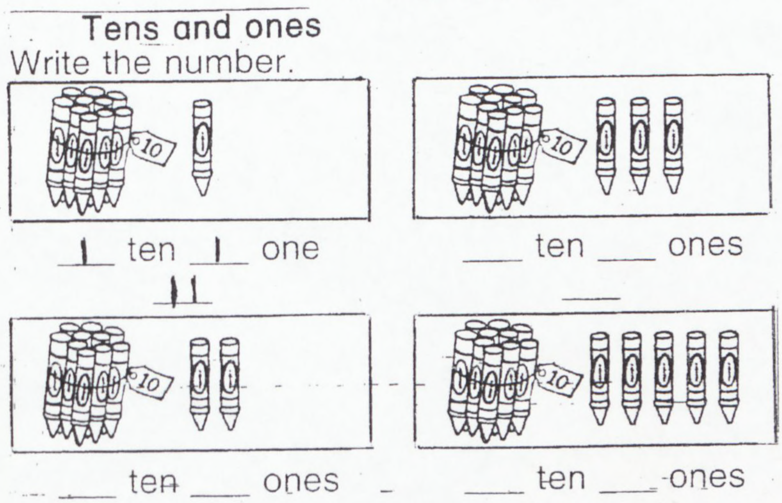
83 + 5 = _____

45 - 3 = _____

55 - 3 = _____

65 - 3 = _____

C. Count the crayons and fill in the missing numbers.



D. Break up the numbers into tens and units. 79 = 70 + 9

85 = ____ + ____ 32 = ____ + ____

99 = ____ + ____ 56 = ____ + ____

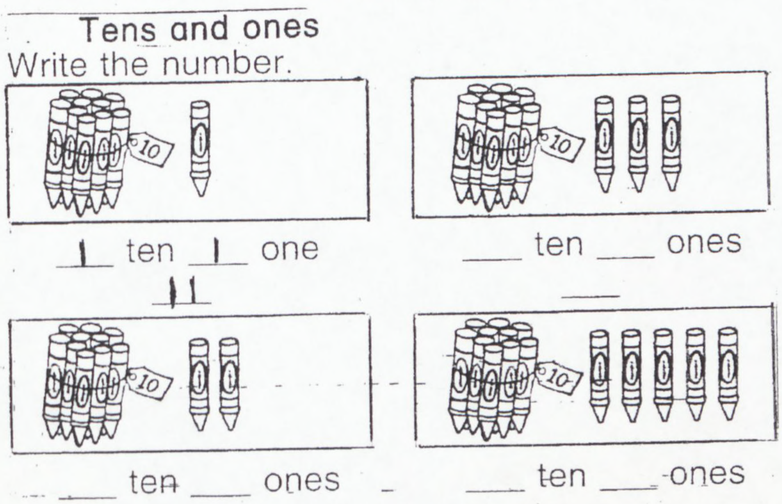
E. Calculate

34 + 20 = ____ 86 - 30 = ____

59 + 30 = ____ 43 - 20 = ____

62 + 40 = ____ 51 - 10 = ____

C. Count the crayons and fill in the missing numbers.



D. Break up the numbers into tens and units. 79 = 70 + 9

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34 + 20 = ____　　　86 - 30 = ____

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